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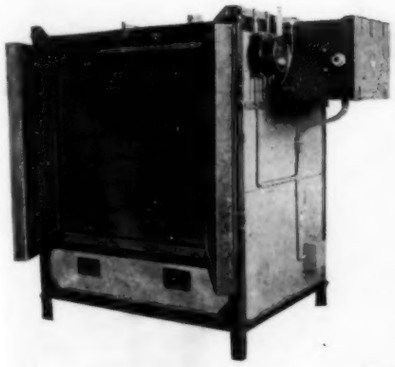

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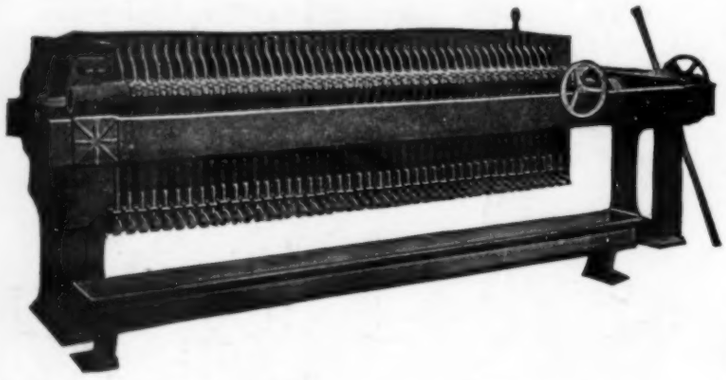

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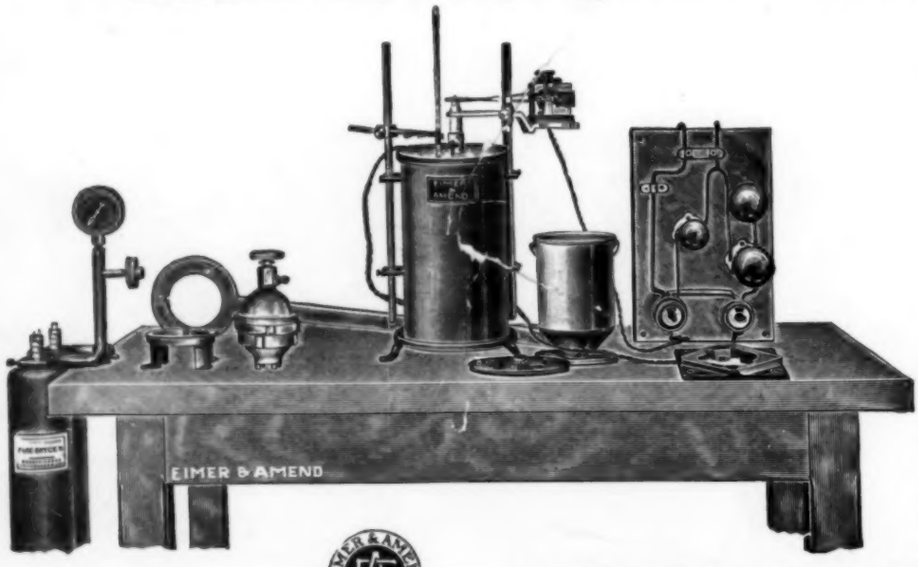

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CHEMICAL & METALLURGICAL ENGINEERING

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The Beet-Sugar Industry Exemplar of Chemical Engineering

MORE than 900,000 tons of sugar will be produced this year from beets in American refineries. Because of its size alone the industry merits technological attention, but from another point of view it is still more significant. The process of getting sugar out of the beets and of purifying it makes use of more of the unit processes of chemical engineering than any other single industry. There are of course material handling problems of great variety, heat transfer problems and others that come under the heading of general technology. Then follow disintegration of the beets, extraction by diffusion, filtration, precipitation, evaporation, crystallization, drying, hydraulic pressing (of beet waste). There are also problems of agitation, of thickening before filtration and many other related or secondary problems. It was for this reason that beet sugar was selected by the program committee of the American Institute of Chemical Engineers as the main subject for the Denver meeting.

We are glad to be able to present in a single issue the series of papers on beet sugar that were presented at the Denver meeting. They represent a wide variety of operating experience and research data on some of the unit processes. The beet-sugar operators' experience with filtration is admirably set forth in Mr. Maudru's paper. Two other papers deal with new processes—one the hot saccharate process of extracting sugar from molasses and the other the barium process of purifying beet sugar. Both are from the Great Western Sugar Co.'s technical staff. Mr. Shafor is recounting in the first paper a research investigation of the company, while Dr. Dahlberg's paper deals with an Italian process and the possibility of its extension to American refineries.

The fourth paper, by Mr. Zitkowski, on the impressive record of cost accounting in beet-sugar production, is a genuine challenge to other industries to make adequate use of a powerful aid in increasing production efficiency. And finally, a paper by Professor Olin and his co-workers at University of Iowa, although not directly connected with beet sugar, deals with a subject that is of universal importance as well to the beet-sugar industry as to all others. Heat transfer through steam-jacketed kettles has been much more neglected than it deserves, and both the method of attack and the results are well worth attention.

The great lesson to be learned from this beet-sugar number is the wide application to other industries of the processes discussed. It reinforces the tenet that chemical engineering is a fundamental technology, that it is a technology of basic processes for many industries rather than a limited technique for a few. It is not too much to hope that every chemical engineering industry will profit from this symposium.

Delayed Reports On Tariff Hearings

CRITICISM of the U. S. Tariff Commission by the chemical industry is increasing as time passes and no report is submitted on oxalic acid, potassium chlorate, logwood extract and barbital, cases in which the hearings were closed in November. It is contended that ample time has elapsed for the submission of the reports on these commodities. Were such cases handled expeditiously, an annoying state of uncertainty could be relieved. Domestic manufacturers of these products will not be in a position to make definite plans for plant operation until the question of import duties has been settled. Importers likewise are at a disadvantage in booking orders for forward deliveries unless they are protected by passing on to the buyer any increase in duties. Naturally buyers are reluctant to commit themselves where cost prices are indefinite, and it is apparent that delays in tariff action are exerting a depressing influence in all branches of the industries concerned.

Impatience also is being manifested because of the apparent lack of progress in the handling of the phenol, linseed oil and cresylic acid cases. The linseed oil case is particularly regarded as important, and those concerned feel they are entitled to action within a reasonable time. Friends of a policy involving a scientific and methodical study of the tariff have regarded the flexible provisions of the tariff act as a safeguard for American industries. Protracted delays in reaching conclusions after investigations have been completed are a cause of disturbance to business and defeat the purpose of the act under which the investigations were inaugurated.

Heat Losses in Ceramic Kilns

WITHIN recent years, tunnel kilns have received serious attention in the ceramic industry and have replaced other types of kilns in plants with products varying from common brick to electrical porcelain and dinner ware. In studying the application of the tunnel kiln in this industry, one is immediately impressed by the fact that fuel savings of 50 to 85 per cent have been demonstrated. In other words, heat utilization in the majority of present ceramic kilns is woefully inefficient.

Those who have had some contact with the industry may wonder at this, for they will perhaps recall having seen waste-heat driers in use with periodic kilns. However, the heat thus used is only a small fraction of the total waste heat available. Only those kilns that are cooling down after the completion of the burn are connected with the driers, air being drawn through the kiln into the drier by means of fans. With sulphur bearing fuels the flue gases contain

sufficient sulphur trioxide to react with the green (undried) ware, forming sulphates that appear as a most undesirable scum on the finished product. Consequently, while the kilns are on fire the flue gases pass directly to the stacks, serving no other useful purpose than merely to create draft. As the maximum kiln temperatures are from 1,800 to 2,800 deg. F., according to product, and the time of burn may be several days, it is obvious that the loss of heat is considerable.

As only the cooling kilns supply heat to the driers under this system, irregularities in burning schedule frequently affect the driers as well, and it becomes necessary to fire directly, a booster furnace being provided for this purpose. That extra fuel should be used at this point while more than an equivalent amount of heat is being wasted up the stack is a serious reflection on the economic sense of the industry.

Many plants have recognized this and in some cases the management has been farsighted enough to accept the recommendations of the engineers and make the capital investment necessary to install tunnel kilns. Appreciable savings can be made even without this drastic step, as has been demonstrated by the use of recuperators and by a system of burning in which the products of combustion from one kiln serve to preheat the ware in another. In spite of this, the prevailing tendency is to balk at the expenditure necessary to effect these economies, presumably because it would come all in one lump, while the money represented by the waste stack gases is distributed over a long period of time. This is an inherent human weakness, but one that must be overcome if the industry is to keep stride with progress.

Where Shall Gas Be Manufactured?

LAST month a joint report was issued by the Bureau of Mines and the City of Buffalo, N. Y., entitled "A Fuel Program for the City of Buffalo," written by G. S. Brewer and B. J. Hatmaker. This report gives the results of a searching inquiry into the question of how Buffalo shall solve the problem of providing its inhabitants with satisfactory supplies of solid and gaseous fuel, in view of the depletion of its natural gas supply and the increasing cost and scarcity of anthracite coal.

One of the features touched on in the report is the proposal that gas be made at the bituminous coal mines —125 miles distant from the city—and transported by pipe line. The estimates given show that a saving could be made by a mine-mouth plant that would amount to 1.23 cents per thousand cubic feet when compared with the cost of transporting the raw coal from the same mines to Buffalo and generating the gas in that city. Despite this advantage, the authors conclude that incidental pipe line leakage would make it more advisable to manufacture the gas at Buffalo.

Of course there are other and special factors that enter into Buffalo's problem. But allowing for these, we must question the decision reached in this case. And if we question it for Buffalo, it will be even more questionable for other cities—cities where there may be no supply of natural gas at hand to bridge over any shortage in coal gas supply. What we have in mind is the unavoidable delays and interruptions of coal transport by rail as compared with gas transport by pipe line.

In this connection there come to mind two installations in widely distant localities. In each of these cases gas is generated at a central point and distributed over a wide area at high pressure in pipe lines. In neither case has there ever been any interruption in gas service to these distant communities due to pipe line transport. However, there have been several occasions when rail service so interrupted the fuel supply that the central gas plants were compelled to reduce their output and just escaped shutdown. If in these cases the gas had been made at the mine-mouth, there would have been no such possibility. Incidentally, no trouble from leakage is experienced in these far-flung gas lines, so that the differential in favor of mine generation found at Buffalo should be worth consideration.

This phase of the matter is but one of several reasons why we think Buffalo may have chosen wrongly. But it seems to be a strong enough reason to influence other cities confronted by Buffalo's problem to decide differently. And if they do so decide, the whole country, and the railroads in particular, will be benefited greatly by the lessened haulage of raw coal and the consequent reduction in the enormous distribution wastes now being made.

What Shall Willie Be "Lerned"?

THERE was once a New York mother who enunciated a philosophy of education. Her youthful son had been returned by the teacher with a request to bathe him. The mother wrote the following classic reply: "Willie aint no rose. Lern him, dont smell him." Mental gymnastics was all that this mother wanted from the school. To make her child a better citizen, a more pleasant companion, a more useful human being, those things had no place in her conception of a school's function.

There has been a deadly parallel between this mother and those who originally perpetrated engineering curricula. The main idea was to "lern" the prospective engineer a mass of material somewhat relevant to his work. Much of it he would never use, but, one could never tell, he might have some occasion to use it. Therefore prepare him for any emergency.

To offset this rudderless drifting the Society for the Promotion of Engineering Education has worked intelligently on the problem. With the co-operation of industrialists and educators it is helping to evolve a type of education for the engineer that will be not only adequate for his professional needs but broadening and balancing. It is therefore of interest to note the outstanding features of this year's meeting at Denver reported in last week's issue of *Chem. & Met.* In our opinion there were two. The first was the report of William E. Wickenden, director of the board of investigation and co-ordination and administrator of Carnegie Foundation Fund, created for studying engineering education.

Thirty-four colleges have already been visited and about forty more will be included in this year's reconnaissance. Collection of extensive data with the aid of the colleges is laying a substantial foundation for reliable conclusions in the many phases of the subject. It is a great work and its promise of results is generous.

The second feature of the program was the discussion of the length of engineering curricula. A number

expressed the belief that longer curricula are the only solution to the dilemma of the educator—the dilemma of trying to teach the student all that he needs in too short a time. Persistent juggling of 4-year courses can hardly result in any but minor advantages, they claim.

This view is shared by a large number of men prominent in the field of chemical engineering education. It seems to be the easiest outlet from a difficult situation. The educator can choose either to sacrifice some subjects that he regards as important or to lengthen the course of instruction. He therefore chooses the latter.

There is one other solution that may ultimately come into its own, but it is fraught with grave difficulties. In every program there are many subjects that are greatly overemphasized. Nearly everyone realizes it. But it cannot be rectified, because the dean or some other important personage is behind the particular subject. Perhaps the most common example is the overemphasis of analytical chemistry in courses of chemical engineering or industrial chemistry. Faculties seem to forget that principles are all that is needed here. The detailed technique of numerous processes of analytical chemistry will be of less use than a course in pipe fitting and neither should absorb the time that should be spent on principles rather than on technique.

If we can only reach the point where a curriculum can be discussed by a faculty freely and openly, without the danger of some one taking offense, we shall have won the battle for an intelligent course and we shall find too that much can be done in 4 years that is now thought impossible. Of course a longer course would be better, but its greater length should be due to cultural courses and not to engineering subjects.

Further Progress Toward Industrial Standardization

WHEN four great engineering societies and the A.S.T.M. jointly established the American Engineering Standards Committee in 1917, they builded better than they knew. What was originally a war effort, designed to establish such co-operation in standardization work as to prevent duplication and the issuance of conflicting standards, has now become one of the most important factors in the advancement of the country's industries. Where originally five engineering societies co-operated with three government departments, there are now 235 national bodies, technical, industrial and governmental, co-operating in the work of the committee through officially accredited representatives and the number of individuals serving on sectional committees is 1,081.

The 1924 year book of this great institution contains much to interest the engineer, as, in fact, has each of the preceding issues of this volume. Of particular interest to the chemical engineering industries are the new projects about to be undertaken establishing a safety code for explosives and writing a standard specification for linseed oil. In addition, work is under way on a gas safety code, the draft of which is now under consideration.

Of course, the above represents but a small fraction of the work taken up by the committee. Since its organization 156 projects for standardization have received official sanction from the committee and of these more than fifty have been completed and the reports made public. Among these completed standards are numbered nine in the field of civil engineering and construction, seven in the field of mechanical engineering, two in electrical engineering, one in automotive industry, six in railroading, eight in metallurgy and nine in chemical industry, in addition to others in miscellaneous fields.

While this work, as detailed above, has been of immense benefit to industry because of the greater production efficiency that such standardization has brought about, and while the projects at present under consideration promise even better things for industry, there still remains an almost infinite amount of such work that can with profit be undertaken. The A.E.S.C. is not an initiating body and work on a project is undertaken only if and when a formal request to do so is received from a responsible body. Also the expenses of such co-ordinating and directing work as the committee does, which are exceedingly small considering the value of the results obtained, are received entirely in the form of subscriptions from member bodies. In the light of these facts, we urge again, as we have in the past, that the chemical engineering industries give this committee their heartiest support and that they contribute as freely as they are able of their time, brains and money to this nationally important work.

Removing Obstacles To the Flow of Heat

THE exponents of modern theory of heat transfer have done a good work. Through their teachings methods have become well known whereby transfer of heat can be accurately controlled and, in many cases, increased if necessary. But the magnitude of the possible increase in rate of transfer is appreciated by but few. While engineers have learned that the rate of heat transfer to or from a liquid in contact with a solid can be varied by changing the velocity of the liquid, it is generally assumed that the possible variation is comparatively small. Recent experiments have shown that it is tremendous.

The successful strengthening of low-carbon steel by heat-treatment, recently mentioned in an editorial in *Chem. & Met.*, provides an excellent illustration of the size of the possible increase. In attempting to stiffen low-carbon steel by heating and quenching, the amount of strength increase depends on the rate at which heat is removed from the hot specimen. It has generally been accepted that the usual speed of heat removal could not be increased greatly, the limiting factor having been assumed to be the conductivity of the steel itself. Even extremely cold quenching baths were used with but small increase in heat transfer rate. Then an engineer tried the use of large quantities of water traveling at high velocity past the red hot specimen, and the tensile strength of the steel treated was increased threefold!

This showed that the limiting factor was not the thermal conductivity of the steel but the rate of heat transfer through the gaseous film of vaporized liquid on the surface of the metal.

It is in interesting agreement with the observed fact that metals may be heated to a higher temperature with blast lamps than with other flames in spite of the fact that the actual flame temperature is lower in blast lamps. The air or gas cushion is swept away by the blast and the metal is less insulated from the flame itself.

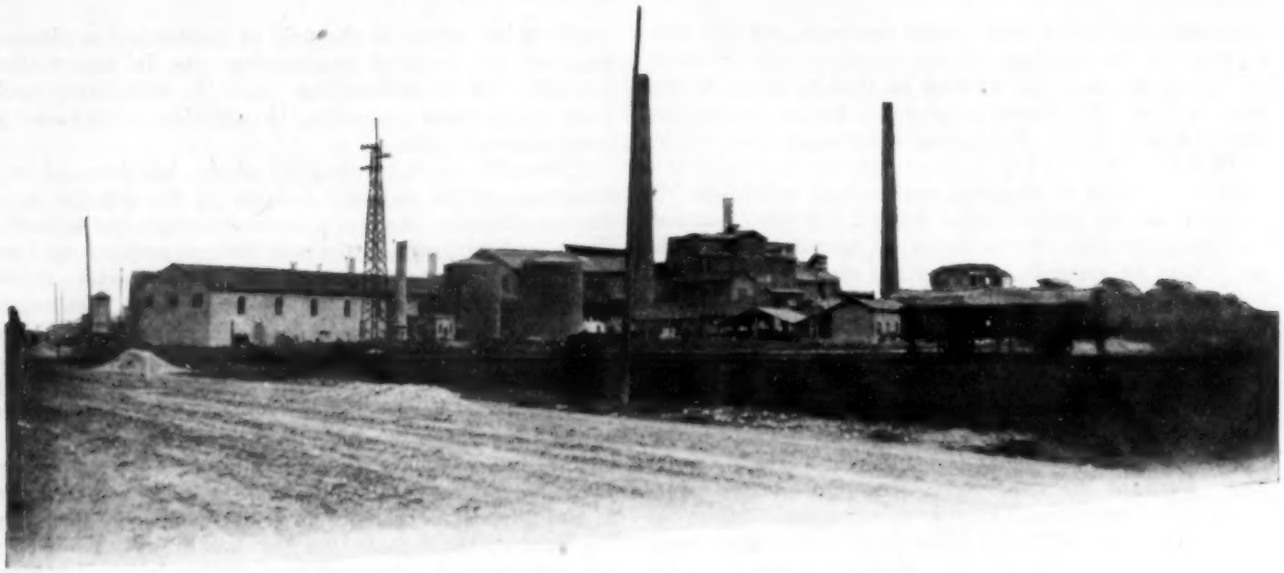


Fig. 1—An Italian Beet-Sugar Plant Employing the Barium Process

Barium Process Shows Interesting Possibilities for Desugarizing Beet Molasses

This Extremely Efficient Method, the Commercial Development of Which Has Been Retarded by the High Cost of Barium Hydrate, Is Able to Operate Successfully Under Italian Conditions

By H. W. Dahlberg
Research Manager, Great Western Sugar Co., Denver, Colo.

IN THE manufacture of beet sugar, a portion of the sugar contained in the beets is finally obtained, not as pure sugar, but as molasses. The amount of sugar lost in this form varies with the amount of non-sugars present in the beets, but is seldom less than 15 per cent of the sugar introduced. The value of sugar in the form of molasses is only 1c. to 2½c. per pound, and it is therefore natural that many efforts have been made to recover this sugar. A ton of beet molasses contains approximately 1,000 lb. of sugar, 600 lb. of inorganic and organic salts and 400 lb. of water. The following is a typical analysis of an American beet molasses: Brix, 86.6 deg.; dry substance, 79.79 per cent; true sugar (sucrose), 50.21 per cent; ash, 13.26 per cent; organic non-sugars, 16.32 per cent. The ash of beet molasses contains approximately: K_2O, 47 per cent; Na_2O, 13 per cent; chlorine, 11 per cent; SO_3, 11 per cent; CO_2, 19 per cent. Potash salts and nitrogenous compounds make up the greater part of the non-sugars.

The principal uses of beet molasses in the United States are as follows:

1. Desugarizing by the Steffen lime process.
2. Yeast manufacture.
3. Cattle feeding.
4. Alcohol manufacture.

The annual production of molasses in this country is about 300,000 tons, of which it is estimated two-thirds to three-fourths is either desugarized or converted into yeast. Beet molasses makes an excellent feed for cattle, although it does not have the pleasant flavor of cane molasses and is therefore entirely unfit for human consumption.

Desugarizing Processes

Of the various processes for desugarizing, the most successful are the Steffen lime, the strontium and the barium processes. These three metals—lime, strontium and barium—are closely related to one another, and all of them form one or more saccharates with sugar. While many reactions of lime, strontium and barium are similar, we also have some striking differences. As far as we know, lime forms at least three saccharates, strontium forms two, and barium only one, the monosaccharate. The Steffen process depends upon the formation of the trisaccharate, the strontium process upon a disaccharate, and the barium, of course, upon a monosaccharate. The Steffen process works best at very low temperatures and high dilution of the molasses,[1] the strontium process requires a very high temperature at or near boiling, with a more concentrated molasses, and the barium process gives the best results with a temperature of 60 to 65 deg. C., with no dilution of the molasses at all.

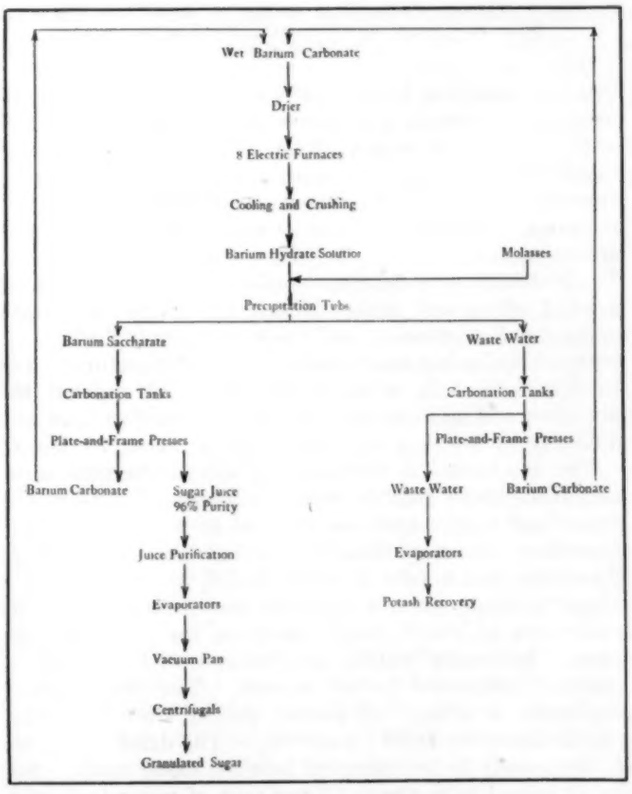
The lime process was developed abroad by Steffen

Presented at the Denver meeting of the American Institute of Chemical Engineers, July, 1924.

[1]Wherever the term "molasses" is used in this paper "beet molasses" is meant, unless cane is specifically mentioned.

and therefore bears his name. Due to many technical difficulties encountered in the early years of the process, it was finally given up almost entirely, so that today there are not over half a dozen factories in Europe using it. The American beet-sugar industry, developed largely during the last 25 years, was therefore in a position to benefit from European experience. With the aid of the Raymond mill for grinding lime and labor-saving presses for filtering the saccharate, many of the difficulties were eliminated, so the process has reached a high state of development with us. The Steffen process has one inherent advantage in that lime must be used for the purification of beet juices, and this lime can be applied just as well in the form of lime saccharate as in the form of hydrated lime. The cost of working a ton of molasses by the Steffen process becomes quite low with modern equipment when only a part of the lime used is properly chargeable to it. This gives the Steffen process such an advantage that at the present time it is used exclusively in American sugar factories, and there are some indications that a number of European plants are again becoming interested in it.

The strontium process was also developed in Germany and France, and is now in active operation at the Dessau refinery in Germany, with several other installations lying idle. In the past when molasses prices were lower it was a very profitable process, but during the war desugarizing was prohibited in Germany and since the war molasses prices have been relatively higher than sugar prices, which makes it less attractive. At Dessau the process has been carried to a fine point, the sugar first being recovered as granulated, and the mother liquor containing the non-sugars being then subjected to destructive distillation in a carefully worked out process. The nitrogen is recovered in the form of sodium cyanide and ammonium sulphate, and the potash either as fertilizer or refined potassium salts. The fact that Dessau is the only European plant using the strontium process would indicate that under existing conditions it is necessary to combine the recovery of non-sugars with it in order to show a profit. For American conditions it has the disadvantage of high installation costs, excessive use of labor and high strontium costs. It is rather doubtful if it will ever be adopted in this country.



Flow Sheet of Italian Barium Process

How the Barium Process Works

This brief outline of the two other leading processes is introductory to the main topic of this paper—the barium process. This process for the recovery of sugar is based on the reaction between barium hydrate or oxide and sugar, whereby an insoluble monosaccharate is formed. This reaction has been well known for many years, having been discovered in France by Peligot in 1838. The commercial process was later worked out by two other Frenchmen, Dubrunfaut and Leplay, in 1849. The first patents were taken out in that year, and the first installation of the process for working molasses was made at La Villette, near Paris. Three other French factories made experimental installations that were operated for a number of years, but all finally succumbed to high prices for barium sulphate and the high cost of converting the sulphate into the hydrate. Leplay continued working on the process and from 1883 to 1885 took out new patents for regenerating barium carbonate by roasting in the presence of superheated steam. Even these improvements, however, were not sufficient to make the process a commercial success, and its use in France soon came to an end.

The greatest obstacle to the complete success of the barium process has always been the high cost of the barium hydrate reagent. The source of nearly all barium compounds is barium sulphate, commonly known as barytes, or heavy spar. There are large deposits of barytes in Missouri and Tennessee, and the raw ore is worth about $10 per ton at the mines. In order to secure barium carbonate, the sulphate, by an old, well-known process, is roasted with coal to form the sulphide, and then carbonated or treated with sodium carbonate to form the carbonate. The net result is that barium carbonate sells in the market for $60 to $70 per ton, while the analogous raw material for the Steffen process, calcium carbonate or limerock, is worth $2 to $5 per ton. Otherwise the barium process is so superior to the Steffen process in the matter of high purity juices that if the barium reagent could be produced anywhere near as cheaply as lime, the Steffen process would probably soon go into the discard. However, by using the barium carbonate obtained in the process over and over again as the raw material for the barium hydrate required, the final cost is greatly reduced, and it is only by the use of such regeneration processes that the barium process becomes feasible. By this procedure, only the small losses of barium carbonate occurring in several steps of the process need be made up from day to day, with fresh barium carbonate made from the sulphate.

A Silicate Conversion Process

A great many patents have been taken out for processes claiming to give a cheap conversion of barium sulphate or carbonate into the oxide, but most of these have been complete failures, and it is not necessary to include them here. Therefore only those methods that give promise of commercial success are described. An interesting process that has been brought out during

the last few years is that which is known as the DeGuide process. It has been patented by the inventor, M. DeGuide, a Belgian, and very strong claims are made for it, but as yet it is still in the experimental stage. The process depends on the formation of barium silicate, presumably in the form of tribarium silicate, by burning barium carbonate and silica together in a cement kiln. This forms a clinker very similar to cement clinker, which is then ground to 100 mesh and treated with hot water. The reaction between barium carbonate and finely powdered silica takes place between 1,250 and 1,270 deg. C., and it is claimed that the material is very friable and that it can be pulverized quite cheaply. It is asserted that the clinker gives a yield of 40 per cent BaO in the form of hydrate, and the remaining insoluble monobarium silicate can be mixed with more barium carbonate and burned to a new clinker. The barium carbonate is thus utilized repeatedly with only small losses of barium. The process sounds very interesting, and if the claims of its owners can be substantiated in practice, will undoubtedly prove of value. It is to be hoped that a commercial installation will soon be made and demonstrate whether the conversion can be made as cheaply as is hoped. Some of the difficulties which may be anticipated are: (1) the kiln lining tending to fuse with the charge, and (2) contamination of the clinker with inorganic salts from molasses.

Operation in Italian Plant

As far as the writer has been able to discover, the only countries in the world where the barium process is now used for the treatment of beet molasses are Italy and Canada. At some time in the '90s the process was developed in Italy, the method of regeneration of barium carbonate being reduction with coal in a reverberatory furnace. About 1901 conversion of the barium carbonate into oxide by means of the electric furnace was developed, and this method is the one in use today (see Fig. 2). The writer had the opportunity of seeing this process in operation and it is working quite successfully under Italian conditions, where the cost of power is from 2 to 5 mills per kilowatt-hour and the cost of common labor is 18 lire per day (about 85 cents at current rate of exchange). The furnace used is quite simple, using two arcs in series, a.c. current at 50 volts, and with no refractory lining. The amount of hand labor required for charging the furnaces and separating the barium oxide core from the unconverted material is very excessive. The dust problem in the furnace room is a serious one and the working conditions would be considered rather bad in the United States. The cost of conversion consists chiefly of the three large items—power, electrodes and labor.

The core of barium oxide obtained from the furnace is crushed and slaked with hot water in a tank provided with stirrers. A solution of barium hydrate of a density of 39 deg. Bé. is obtained, and this solution, after most of the insoluble matter has been settled out, is ready for the precipitation of sugar. The settling is done in a series of tanks, called hydrators, and about once a week the sediment at the bottom of the tank is leached several times with boiling water and then run to a filter press, where it is washed as free as possible of soluble barium. As you will notice, this part of the installation is rather crude and could be greatly improved in a new plant.

The barium hydrate solution having been obtained, it is run to a storage tank and from there to a compartment trough above the precipitation tubs. Ten of these compartments are filled to a certain volume with the hydrate solution at a temperature of 80 deg., and ten other compartments with molasses at about 36 deg. The hydrate solution is run into the precipitation tub first, followed immediately by the molasses; after a slow stirring by hand for about a minute the reaction is complete and the tub is nearly full of solid, coarse-grained saccharate, which looks and feels very much like sea sand. Near the bottom of each tub is a 22-mesh iron screen, laid in loose with a rubber gasket around the edge. About two ordinary bucketsful of cloudy mother liquor or waste water is caught when the valve at the bottom of the tub is first opened, and this is poured back on top. The waste water then runs clear, and after this has drained off for a short time, the washing with a hot solution of 2 per cent barium hydrate begins.

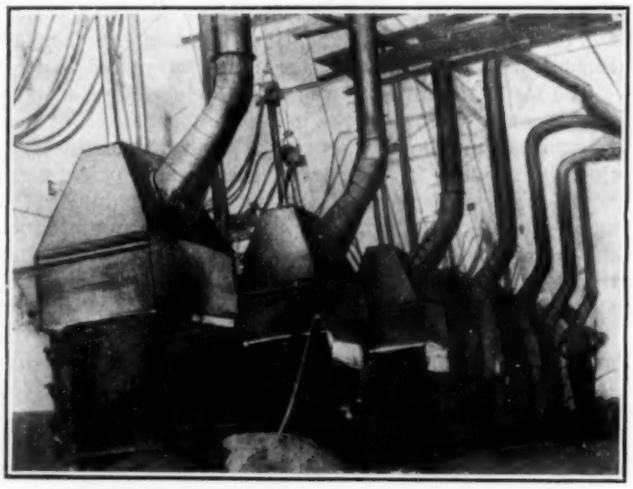


Fig. 2—Electric Furnaces in an Italian Beet-Sugar Plant. These Are Used for Converting Barium Carbonate to Barium Oxide

The first washing is done by wash water that has been used once before in a previous washing, and is followed with fresh wash water. Each tub handles 800 lb. of molasses at a time, and there being ten tubs, it takes fourteen cycles in 24 hours to handle 56 tons of molasses. Four men per shift are required to run the entire station.

The dumping is done by tipping the tub by means of a hand wheel and gear. Nearly all of the saccharate slides out immediately, and the remainder is flushed out with a hose, using sweet water. The temperature of the saccharate is held at about 65 deg. C. throughout the filtration and washing period. This is done without any difficulty by keeping the wash water at about 70 deg. C.

The saccharate is scrolled to a saccharate milk tank, and from there goes to juice carbonation. The mixed waste and wash water are pumped to waste water carbonation, one man handling all of the carbonating. From the saccharate a white $BaCO_3$ is obtained, and from the waste water a yellow or brown carbonate. The two types of $BaCO_3$ cake, one from the juice and one from the waste water, are filtered and washed in ordinary plate-and-frame presses. The waste water carbonate is always of poorer quality than the other and is therefore dried separately. The dried carbonate is then ready to be converted into the oxide again, after being mixed with about 4.5 per cent of pulverized coke.

The sugar juice obtained from the carbonation of

the barium saccharate is of very high purity, about 96 per cent, and the production of white granulated sugar from it offers no technical difficulties.

Insoluble impurities gradually accumulate in the sediment formed in the bottom of the settling tanks or hydrators, and when this sediment gets as low as 50 per cent $BaCO_3$ by analysis, it is finally washed as thoroughly as possible and then discarded.

In order to be successful in the United States, the Italian process would have to be worked under the following conditions:

1. Large margin between the cost of molasses and sugar.
2. A tonnage of molasses sufficiently large to operate a plant the year around.
3. A plant with labor-saving equipment developed to the last degree.
4. Utilization of the non-sugars in the form of marketable byproducts.

In conclusion, it should again be emphasized that the success of any barium process for the recovery of sugar from molasses rests primarily upon the cheap regeneration of barium oxide, and it is to be hoped that the interest now being taken both here and abroad in the utilization of molasses will result in the development of better processes for making barium oxide or hydrate.

Cost Accounting—An Industrial Accelerator

How a Highly Developed System of Accounting Has Been Responsible for Marked Improvement in Production Efficiency and Operating Control in the Beet-Sugar Industry

By H. E. Zitkowski

General Chemist, American Beet Sugar Co., Oxnard, Calif.

SINCE chemical engineers concern themselves not only with the "how" but also with the "how much" of their problems, it is perhaps presumptuous to emphasize here the importance of technical accounting to the chemical engineer. During the infancy of the development of any technical problem, the qualitative phases demand and deserve greatest attention, but unless the quantitative phases of the problem are given equal or even greater care, the life expectancy of the problem will classify it as a poor risk in the business mortality tables. This is as it should be.

It is in the nature of things that the sugar industry, owing to its age, its comparatively standardized processes and keen, worldwide competition, should have developed its quantitative technical accounting methods to a greater degree of refinement than most similar industries. Furthermore it is well to emphasize that while competition is keen, a wider, freer exchange of comparative technical—not financial—operating data exists among the hundreds of sugar producers than among any similar group of manufacturers.

Adds Stability to Industry

More than 30 years ago a comparative operating control was instituted by a large number of Belgian, Dutch and German sugar manufacturers. This was directed by a competent engineer, with headquarters in Brussels, to whom all reports were sent, who reduced the data to comparable units, edited, compiled and published them for distribution. Each plant was given a key letter, and each member of the association received complete data covering the entire group. Similar co-operative bureaus were established between French and Russian producers and also in the cane sugar producing countries. Perhaps the most elaborate system of this nature now in existence is among the large group of Javanese sugar producers. Their mutual reports cover even the minutest details of operation having possible influence on the final results. That such data are invaluable to the sugar technician, operating under fairly similar conditions, is obvious. And how has this expressed itself in the market level of the product, sugar? Excepting the period during and since the World War and the temporary fluctuations occasioned by world-wide crop failure, the price of sugar definitely tends downward, as Table I indicates.

Table I—Wholesale Prices of Sugar, 1870–1913

Year	N. Y. Wholesale Price of Granulated Sugar, Cents per Lb.	Year	N. Y. Wholesale Price of Granulated Sugar, Cents per Lb.
1870	13.53	1900	5.32
1880	9.60	1910	4.97
1890	6.17	1913	4.28

In the spring of 1914, just before the outbreak of the war, the price actually decreased below 4c. per pound. Duty-free raw sugars, of about 96 deg. purity, in the primary markets at that time were selling in the neighborhood of 2c. per pound.

If it is now considered that this total price includes the very considerable item of the cost of raw material, the costs of transportation, all costs of materials and labor in the process of manufacture, as well as all overhead and profit, the fact will be appreciated that when comparing costs and efficiencies of operations the sugar producer must reckon his costs not in cents per pound, nor even in mills per pound, but in tenths of mills per pound. On the other hand, owing to the volume of production, even at the rate of tenths of mills per pound, the totals assume considerable proportions. The larger of the beet-sugar companies in this

Presented at the Denver meeting of the American Institute of Chemical Engineers, July, 1924.

Daily Operating Report of a Typical American Beet-Sugar Plant

B Factory, 87th Day, from 6 A.M. Oct. 28 to 6 A.M. Oct. 29, 1920

Tons	Last 24 Hr.	To Date	Daily Ave.	Last 24 Hr. % Sugar	Last 24 Hr. Purity	Last 24 Hr. % Tare	To Date % Sugar	To Date Purity	To Date % Tare	Days Yet To Operate
Beets received	655	226099	2600	19.42	81.2	3.95	18.82	80.6	3.80	..
Beets sliced	1691.605	222103.709	2552.9	18.68	80.7	....	18.76	80.4	....	4
Bags sugar	7585	802447	9227							
Bags dried pulp	2038	224224	.....							
Bags mol. pulp	.....	38831	.....							
Total bags pulp	.....	263055	3024							
Tons crude potash	8.310	1089.166	12.52							

		Last 24 Hrs. Total Tons	Last 24 Hrs. % on Beets	Last 24 Hrs. % on Sug. Entered	To Date Total Tons	To Date % on Beets	To Date % on Sug. Entered
1	Total sugar entered	315.992	18.68	100.00	41671.118	18.76	100.00
2	Sugar in pulp	1.692	.10	.54	247.831	.11	.59
3	Sugar in waste water	.677	.04	.21	87.945	.04	.21
4	Sugar in lime cake	2.768	.16	.87	199.942	.09	.48
5	Sugar in Steffen waste water from	4.704	.28	1.49	332.186	.15	.80
6	Total known losses	9.831	.58	3.11	867.904	.39	2.08
7	Sugar bagged	379.250	22.42	120.08	40122.350	18.07	96.28
8	Sugar estimated in process (gran. equiv.)	.....	.....	.....	100.000	.05	.24
9	Sugar melted bght. or from prev. camp. (gran. equiv.)	.....	.....	.....	89.826	.04	.22
10	Net extraction	.....	.....	.....	40132.524	18.08	96.30
	Molasses Statement						
11	Sugar in molasses produced	135.087	7.98	42.76	10832.217	4.88	26.00
12	Sugar in molasses worked in Steffen	135.087	7.98	42.76	10832.217	4.88	26.00
13	Total sugar in mols. to pulp plant	.....	.....	.....	236.942	.11	.57
14	Wet molasses produced	257.800	15.24	81.57	21315.800	9.60	51.18
15	Wet molasses worked in Steffen	257.800	15.24	81.57	21315.800	9.60	51.18
16	Total wet molasses to pulp plant	.....	.....	.....	442.658	.20	1.06
17	Steffen extraction (12-5 in., per cent of 12)	.....	96.57%	.....	.....	96.93%	.....
18	Steffen waste produced per cent wet molasses worked	2240-869%	.....	.....	197501-926%	.....	.....
	Pulp Statement						
19	Dried pulp bagged	101.900	6.02	32.24	11211.200	5.04	26.90
20	Molasses pulp bagged per cent mol. day to date	.....	.....	.....	1941.550	.87	4.66
21	Total pulp bagged	.....	.....	.....	13152.750	5.91	31.56
22	Lbs. fuel oil to 100 lb. dried pulp produced	.....	35.5	.....	.....	38.0	.....
	Material Statement			% on Sug. Ext'd			% on Sug. Ext'd 0
23	Lime entered in carbonations (slaked and powder)	129.798	7.67	34.22	11507.197	5.18	28.6
24	Total lime used	129.798	7.67	34.22	11507.197	5.18	28.68
25	Lime entering coolers to 100 sug. in mols. worked	129.798	96.1%	.....	11038.048	101.9%	.....
26	Vertical lime produced	126.408	7.47	33.33	10152.945	4.57	25.29
27	Vertical waste per cent vertical prod	.....	.....	.....	100.806	.99%	.....
28	Rotary lime produced from lime cake	20.741	1.23	5.47	1752.689	.79	4.37
29	Spall lime produced from spalls	15.001	.89	3.98	639.647	.29	1.59
30	Rotary lime used per cent total lime used	20.741	15.99%	.....	1752.689	15.24%	.....
31	Spall lime used per cent total lime used	15.101	11.64%	.....	639.647	5.56%	.....

	Fuel Oil	*Last 24 Hr.*	*To Date*						
32	B. H. factory	1397.3 Bbl.	125993.0 Bbl.	227.421	13.45	81.44	20505.474	9.24	51.10
33	B. H. potash mfr.	153.2	16190.0	24.933	1.47	6.57	2664.958	1.20	6.64
34	B. H. total	1550.5	142183.0	252.354	14.92	8.01	23170.432	10.44	57.74
35	Pulp plant	228.8	31591.8	36.150	2.14	9.53	4993.027	2.25	12.45
36	Rotary kilns	60.2	5005.4	9.798	.58	2.58	814.040	.37	2.03
37	Spall kiln	32.2	1353.3	5.240	.31	1.38	220.791	.10	.55
38	Total fuel used	1871.7	180133.8	303.542	17.95	101.50	29198.290	13.16	72.77
39	Cold water 14 million gal. 1253	.....	.....	.....	3452%	.....	.....	2353%	.....
40	Boiler feed water	.....	.....	3944.5	233.1	.....	345656.0	155.7	.....
41	Lime rock	.....	.....	202.450	11.97	53.39	18333.800	8.26	45.68
42	Lime rock as spalls	.....	.....	28.510	1.69	7.52	1227.500	.55	3.06
43	Coke	.....	.....	23.980	1.42	6.32	2110.935	.95	5.26
44	Sulphur	.....	.....	.887	.05	.23	80.239	.04	.20
45	Soda to juices	.....	.....	4.850	.29	1.28	423.400	.19	.06
46	Total soda used	.....	.....	5.100	.30	1.35	449.493	.20	1.12
47	Kieselguhr	.....	.....	1.222	.07	.32	110.215	.05	.27
48	Wash water used on carbonation filters	.....	.....	910	% on Cake	109	94737	% on Cake	148
49	Wash water used on cold saech. filters	.....	.....	.....	% on Cake	.....	.....	% on Cake	.....

Diffusion Batteries							Pans: Last 24 Hours						Pans: To Date						
	No. in Oper.	No. Cells in Cell	Tons Per Cell	Per Cent dil	Pr. Ct. Draft by Wt.	Time of dif.	Qual.	No.	App. Purity Fill-Mass	App. Purity Green	Total Drop	Theo. Yield	Hr. Cryst.	No.	App. Purity Fill. Mass	App. Purity Green	Total Drop	Theo. Yield	Hr. in Crys.	Cu.Ft. Fillm. T. Beet
Today	2	20	6.1	54	150	1° 44′	Str.	10	84.2	70.2	14	56	.....	1076	84.1	71	13.1	54	.....	12.02
To date	.....	.....	6.1	54	158	1° 36′	Raw	9	72.4	56.1	16.3	51	32	507	71.5	55.2	16.3	51	44	3.24

Battery extraction: sugar in diff. juice today 312 tons, 98.1 per cent on sug. ent. To date 41296, 99.1 per cent on sug. entered. Temperature; bat. max. 80° C. Ave. before lime, 90° C. Before 1st filter, 90° C. Before 1st refilter, 93° C. Before 2nd filter, 101° C. Finished cooler, 16° C. Hot saech., 86° C. Leaving thickener 84° C.

country will produce perhaps 600,000,000 lb. annually and a difference of one-tenth of a mill per pound amounts to $60,000. So the extensive technical control in use has been developed more or less of necessity.

A typical American factory superintendent's daily operating report is shown herewith. In form, these reports will vary more or less among the different sugar companies, though in substance practically the same data are compiled by all. This is the final criterion of the technical operating results and is compiled and calculated from literally dozens of various agricultural, factory station, laboratory and supply warehouse reports, to go into the detail of which would be entirely beyond the scope of any one paper. Each item on this report is a problem in itself.

Consider for a moment the first item on this report, "Beets Received." The plant in which the report here being considered originated pays the grower of beets on a basis of the sugar content of the beets delivered by him, with the result that each load, as delivered, is sampled, and occasionally as many as 1,000 samples per day are received for analysis. The problem here begins with the proper and correct sampling of the load. Individual beets vary widely in sugar content, even though they were neighbors in the field, so that it becomes a real problem to obtain a representative sam-

ple under all conditions. Sugar is not uniformly distributed in the beet itself, so that a further problem is involved in obtaining an aliquot portion from each beet in the sample for analysis. The most practical and efficient method of determining the sugar content in beets under all conditions is still a subject for discussion, although it is prescribed by law in at least one state.

Similar problems arise with each of the other items on the report involving sampling, analyses, weight and measurements. It is worth while to discuss for a moment the subject of sampling the many dozens of products or stages of the intermediary steps in the process of manufacture. The probability of error creeping into the results, due to incorrect sampling, willful or otherwise, is greater than is the case with most products; yet chemists will devote greater attention to the details of analysis than to the methods of obtaining their samples for analysis, with the result that, say in the matter of the determined losses, a beautiful record is established and the unaccountable losses are equally as great as those accounted for.

"The Human Element in the Mill," so ably discussed by H. K. Moore in a paper before the American Institute of Chemical Engineers some years ago, is perhaps the most important factor to consider in the matter of sampling. The superintendent in charge establishes certain permissible limits, as an illustration, for the loss of sugar in the pulp and when there are variations from these limits, he expresses himself, often not too gently. The operators of the diffusion battery, like most of us, prefer to avoid trouble, and if experienced, often know before analysis is made that the pulp will be high, although the cause may not be within their control. The result is often a doctored or salted sample, and as a consequence large unaccounted losses at stocktaking periods. But even so, very gratifying progress has been made in this direction. It was not so many years ago that superintendents rated the value of some of their foremen and workmen on the basis of their ability to "put it over" on the laboratory; happily that day is practically past.

Table II—Comparative Slicing Capacity and Sugar Extraction in Two Plants Over a Period of 33 Years

	Factory *A*		Factory *B*	
Year	Average Daily Slicing in Tons	Average Extraction of Sugar in Per Cent	Average Daily Slicing in Tons	Average Extraction of Sugar in Per Cent
1891–92	178	51.52	.....	.....
1892–93	234	67.03	.....	.....
1893–94	214	62.16	.....	.....
1894–95	Not operating	.....	.....	.....
1895–96	267	59.95	.....	.....
1896–97	348	64.74	.....	.....
1897–98	357	64.78	.....	.....
1898–99	294	71.33	.....	.....
1899–00	251	71.40	1,193	82.49
1900–01	Not operating	.....	1,044	81.92
1901–02	Not operating	.....	1,418	82.67
1902–03	318	79.20	1,420	89.37
1903–04	337	80.50	1,432	83.23
1904–05	367	78.56	1,696	85.30
1905–06	323	77.07	1,498	87.86
1906–07	306	78.68	1,650	85.82
1907–08	333	75.48	1,643	90.52
1908–09	362	68.76	1,744	89.63
1909–10	283	66.55	2,142	90.38
1910–11	364	73.40	2,600	90.30
1911–12	394	70.12	2,657	90.12
1912–13	395	73.81	2,443	93.93
1913–14	412	71.61	2,406	90.82
1914–15	400	74.42	2,822	90.04
1915–16	441	75.20	2,715	92.86
1916–17	430	72.92	2,602	95.25
1917–18	427	73.61	2,327	92.82
1918–19	468	87.61	2,035	96.02
1919–20	444	86.46	2,096	97.30
1920–21	468	86.52	2,536	97.29
1921–22	510	88.93	2,780	97.13
1922–23	496	90.15	1,170	97.01
1923–24	533	88.98	1,680	97.43

Referring again to the report, it will be observed that this gives the quantities of the various products and materials of importance in the process, both for the last operating day and to date, expressed in terms of per cent on beets and in terms of per cent on sugar entered. Thus it presents a comprehensive and continuous picture of the operating results. With this before him and comparing these results daily with results obtained in previous years or at other plants, the superintendent can readily determine the weaknesses of his operations and can concentrate on these.

Improving Operating Efficiency

That these efforts, striving for increased operating efficiency, although slowly, have in the course of time resulted in very definite results may be gathered from the data presented in Table II.

Factory *A* refers to one of the pioneer plants of the country, and although now it is one of the smallest, at the time of its erection it was hailed throughout the country as a mammoth new beet-sugar factory, destined to revolutionize the agricultural and business conditions of the West. It did play an important part. It served as a training school for several score of men, who, 8 to 10 years later, when the active development of the American beet-sugar industry took place, were prominent in the operation of new plants. Factory *A*, owing to its small size, age and location in a territory not favored with an average quality of beets, is not one of the most efficient in the country, and the data are not given in that light, but rather as being of historical interest.

Factory *B*, although likewise one of the older plants of the country, is one of the largest and more efficient plants. Here, however, changing agricultural and economic conditions have had an adverse influence on the supply of raw material, and during the past half dozen years an irregular or short supply of raw material has not permitted this plant to develop its maximum efficiency in all directions.

Note the slow, but appreciable, increase in slicing capacity with the years. This increase was brought about not by additions to the size of the plant. Although weaknesses as they develop were strengthened, in Factory *A* the original diffusion battery of fourteen cells is still in service and a few years ago one additional cell was added. The increase in slicing capacity is due largely, however, to a better trained operating force, to the elimination of a multiplicity of interruptions, mechanical and chemical. As the process is practically continuous, an interruption at any one point stops the operations of the entire plant. In the early years of the industry in this country it was the usual practice to close down the entire plant once each week for no less than 24 hours in order to go over the entire equipment. This was due in part to necessity and in part to a bad habit imported from abroad. It was often necessary to "boil out" the evaporator heating surfaces with acid solutions each week, and to remove the enormous scale deposits that formed. Today, owing to the careful control and the elimination of lime salt formation, evaporators occasionally run through 80 to 100 days, without excessive fouling of the heating surfaces. Furthermore, improved arrangements have been made, by which any effect of a quintuple effect evaporator can be boiled out without seriously interrupting the operations of the remaining effects. This and numerous other factors account for the increased capacities over

those originally obtained. There are many plants in this country that obtain proportionately even greater increases than those shown in the table. In this direction American beet-sugar operators have outdistanced anything accomplished in European practice. European sugar men usually look with astonishment at the slicing rate that is obtained in this country from given equipment.

Equally gratifying is the increase in extraction—that is, the recovery of sugar in terms of the percentage introduced in the beets. It should be pointed out that in the case of Factory *A* the Steffen process for the recovery of sugar from molasses was installed in 1917; up to this time this was a milk of lime, non-Steffen plant. Factory *B*, however, was originally equipped with the Steffen process and its extraction is wholly from that of sugar introduced in beets, since no additional sugar in the form of molasses or otherwise was introduced. Conditions in this house are usually favorable for a high extraction. However, it was not always so, and the improvement is due mainly to a very rigorous chemical control, with the full co-operation of the entire operating force. Just what this difference in sugar recovery may mean in the financial results may readily be seen from a few figures. Factory *B*, during several of its operating seasons, has introduced more than 100,000,000 lb. of sugar; a difference of 1 per cent in the extraction means 1,000,000 lb. of sugar at 5c. per pound, worth $50,000 for each per cent. The extraction of Factory *B* during recent years has been more than 10 per cent above the results of the early years of its life, and 10 per cent means half a million dollars worth of additional sugar recovered per season. This shows the possibilities and rewards of a closer technical control and increasing efficiency.

Factors Affecting Fuel Consumption

Similar progress has been made in other directions as shown in Table III. The figures for Factory *A* are given, not because they are particularly meritorious, for they are not (there are many plants that fall below 100 lb. of coal per 100 lb. of sugar), but rather because as a pioneer plant its record does show the results obtained during the early days of the beet-sugar industry in this country and the progress that has been made since that time. In considering Factory *A* it must be remembered that the Steffen process, which increases the fuel consumption in per cent of beets, although not necessarily in per cent of sugar produced, was added in 1917. Minor fluctuations of fuel used, especially in relation to per cent of sugar produced, are due to a difference in the quality of the beets, to a difference in the quality of the fuel and to factors not within the control of the factory operators, such as an inadequate supply of beets. In the main, however, the tendency of fuel consumption has been downward, especially on the basis of sugar produced, until today a fair average figure the country over is in the neighborhood of 1 lb. of coal per pound of sugar produced.

Many factors are responsible for this decreased fuel consumption. One of the most important is the increase in slicing capacity, since there is a certain fixed fuel consumption due to power requirements and radiation losses. This aptly termed "overhead" of fuel consumption decreases with increasing capacity. Radiation losses, of course, have been reduced by better and more extensive isolation, and the power requirements and friction losses have been lowered, although the actual heat or fuel requirements for these items are of lesser importance, since all exhaust steam is fully utilized for heating and evaporation. Multiple utilization of vapors, not only by the fairly general use of quintuple evaporators but also by the use of low-pressure vapors for heating vapors below atmospheric pressure, where this is applicable, has been in a large measure responsible for lowering fuel consumption. The increased extraction has had its influence in reducing fuel to sugar consumption. Increased boiler house efficiencies, such as the careful utilization of the hot condensates for boiler feed, have added an important share in reducing fuel consumption. A better criterion of process steam economy would be steam consumption rather than fuel consumption, but records of steam consumption or water evaporated in the boilers in the early years were not kept.

A full measure of success has attended the efforts toward labor reduction. In the early days of the industry in this country from 6 to 8 factory labor hours were required per bag of sugar of 100 lb. Recently H. W. Dahlberg reported that the most efficient factories under his observation had obtained figures of 29 minutes of operating labor per bag of sugar. And the ultimate limit has not yet been reached.

Table III—Comparison of Fuel Consumption in Two Plants During a Period of 33 Years

	Factory *A* Coal		Factory *B* Oil	
Year	Per Cent on Beets	Per Cent on Sugar Produced	Per Cent on Beets	Per Cent on Sugar Produced
1891–92	23.65	353.30	.....	.....
1892–93	26.90	288.30	.....	.....
1893–94	34.70	426.48	.....	.....
1894–95	Not operating	.....	.....	.....
1895–96	19.40	317.72	.....	.....
1896–97	20.50	246.80	.....	.....
1897–98	21.37	242.76	.....	.....
1898–99	19.00	195.10	.....	.....
1899–00	19.00	186.75	16.64	116.3
1900–01	Not operating	.....	21.14	142.0
1901–02	Not operating	.....	18.16	133.7
1902–03	22.56	211.90	17.54	124.4
1903–04	22.20	181.71	15.31	108.8
1904–05	21.50	188.33	11.94	87.3
1905–06	22.58	332.72	12.71	81.90
1906–07	24.99	228.76	12.67	86.00
1907–08	22.26	180.94	12.40	77.30
1908–09	18.44	185.78	10.48	63.00
1909–10	21.21	235.31	9.77	60.10
1910–11	20.28	169.13	8.48	49.80
1911–12	18.60	141.62	8.66	50.00
1912–13	19.00	151.66	9.78	52.80
1913–14	17.90	157.54	9.30	53.25
1914–15	18.18	172.92	9.16	52.14
1915–16	19.14	154.15	9.88	57.49
1916–17	17.58	173.09	10.29	55.98
1917–18	18.36	220.02	11.26	59.02
1918–19	17.21	135.92	10.17	61.10
1919–20	15.36	140.71	10.01	54.97
1920–21	16.92	140.26	9.39	51.45
1921–22	15.92	119.52	8.82	49.95
1922–23	16.55	131.26	12.67	66.84
1923–24	15.24	135.51	10.86	56.62

While the quantity requirements of materials and labor have decreased, the cost of these items have not decreased in anything like the same proportion. The quantity of coal required per ton of beets has been cut into half or less, but the cost of coal per unit has doubled or more, leaving the actual cost of coal per ton of beets worked as great or even greater. In the matter of labor there has been an actual net reduction of costs, even though labor costs per unit of time have increased 300 to 400 per cent.

The cost of the raw material, beets, has actually increased throughout the years.

The greatest single factor responsible for the decreasing market price of sugar through the years is to be found in the increased extraction or percentage recovery of sugar in the raw material, and to this technical accounting has contributed a large share.

A Problem in Beet Sugar Production

Improvements in Hot Saccharate Process

Chemical Engineering Involved in Recovering the Last 10 Per Cent of Sugar as Carried Out in Four Plants

By R. W. Shafor
Great Western Sugar Co., Denver, Colo.

THE hot saccharate process, as used in America, is not one of the most important steps in the beet sugar process from an economic viewpoint, but it is often one of the most troublesome from the standpoint of the factory operator. This is probably due to the fact that, so far as general usage is concerned, it is still in its infancy. The first installations were, I am informed, two or three in number and were made about 25 or 30 years ago. Aside from these, no installations were made until about 1915, when, with the advent of war-time sugar prices, it became more attractive economically. During subsequent years it has come into rather general use throughout the industry in this country and with this has come a considerable development which appears to insure it a permanent place in the Steffen process flowsheet.

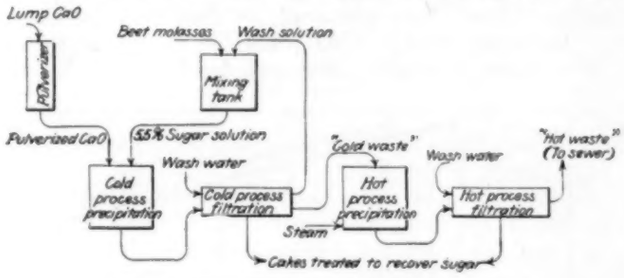


Fig. 1—Flow Sheet for the Steffen Process

The accompanying diagrammatic flowsheet, Fig. 1, illustrates the Steffen process for the recovery of sugar from beet molasses. It may be divided into two subprocesses, the first known as the cold saccharate process and the latter as the hot saccharate process, with which this paper is concerned. A brief description of the operation of the two will probably assist those not familiar with beet sugar operations toward a better understanding of that which is to follow.

In the cold saccharate process, beet molasses is diluted so as to form a solution containing approximately 5.5 per cent sucrose, and this solution is treated, usually at a temperature of 15 deg. C. or less, with finely powdered lime in sufficient quantity to precipitate from 85 per cent to 90 per cent of the sugar present. The resulting precipitate is separated from the "mother" solution by filtration and subsequent washing. The solutions resulting from washing the filter cakes are usually employed in diluting molasses to be treated. The "mother liquor," known as "cold waste," in addition to most of the impurities that were present in the original molasses, contains sugar to the extent of from 0.5 to 0.8 per cent and a quantity of lime. This "cold waste" is the raw material from which sugar is recovered by the second or hot saccharate process.

The hot saccharate process consists of two operations. The first of these involves heating the "cold waste," above mentioned, to a temperature of approximately 80 deg. C., a procedure that causes the formation of a precipitate consisting of sugar and lime. Lacking a more definite name, this precipitate is generally termed the "hot saccharate precipitate." The second operation consists merely of separating this precipitate from its mother solution, known as "hot waste," which is discarded.

The basic chemistry involved in the Steffen process deals with the compounds of calcium oxide and sugar. These compounds are generally considered to be addition products with the general formula $x\text{CaO}.C_{12}H_{22}O_{11}$ and are relatively unstable. A number of such compounds are described in the literature, but those with which we are most concerned contain four or less molecules of CaO per molecule of sugar. In the cold saccharate process the precipitate formed is generally believed to be the tricalcium saccharate, $3\text{CaO}.C_{12}H_{22}O_{11}$. The precipitate formed in the hot process, as we shall show later, is probably the tetracalcium saccharate. $4\text{CaO}.C_{12}H_{22}O_{11}$.

Little information, of value or otherwise, has been published and probably not a great amount is known of the detailed chemistry of the hot process. The data presented here on this phase of the subject are the result of investigations made by the research organization with which the writer is associated, and while not complete, are considered dependable.

The curves in Fig. 2 illustrate the typical precipitation-temperature curve involved. In this particular case the "cold waste" solution contained 0.52 per cent sugar and an alkalinity equivalent to 0.74 per cent CaO at 10 deg. C. A quantity of this cold solution was

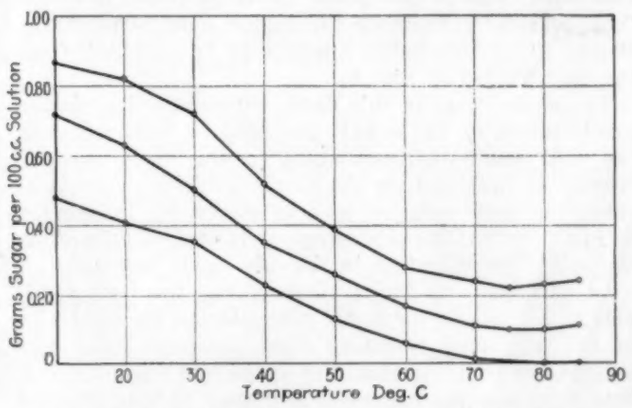


Fig. 2—Precipitation-Temperature Curve for Hot Saccharate

Presented at the Denver meeting of the American Institute of Chemical Engineers, July, 1924.

heated to 30 deg. C. and the precipitate filtered out to produce a solution with sugar content and alkalinity as plotted on the 30 deg. abscissa. Another quantity was heated to 40 deg. C., and so on until at some point between 80 and 90 deg. C. the resulting solution showed a neutral polarization.

At first glance these curves would seem to justify the conclusion that the precipitation involves simply the temperature-solubility relationship of a compound that is present in the "cold waste." Data to be given indicate, however, that such is not the whole case and that a chemical reaction equilibrium is probably involved.

On this point the curves in Fig. 3 indicate that a hot waste free from sugar is not always a possibility. These curves represent the temperature-sugar concentration relation obtained as in Fig. 2, when cold wastes containing 0.48 per cent, 0.72 per cent and 0.87 per cent sugar are heated to the temperatures indicated and the precipitate removed. It will be noted that the lower curve which resulted from heating the 0.48 per cent sugar cold waste yielded a final waste containing no sugar; that the treatment of the 0.72 per cent cold waste resulted in a final waste containing 0.10 per cent sugar, and that the 0.87 per cent waste gave a final figure of approximately 0.22 per cent sugar. From these curves two deductions are apparent.

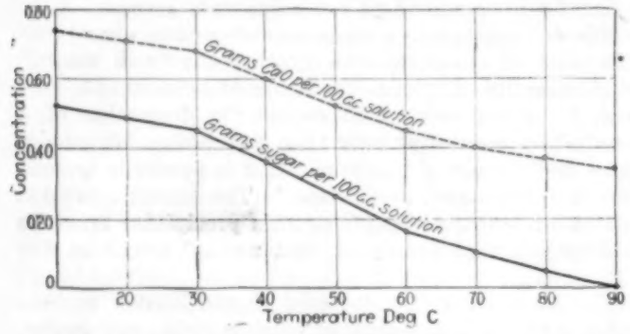


Fig. 3—Relation Between Temperature and Sugar Concentration in Heated Wastes

First—That for all concentrations of sugar in the cold waste (within the range covered) a temperature of from 75 to 85 deg. C. yields the maximum recovery.

Second—The quantity of sugar remaining in the final waste is a function of the concentration present in the cold waste treated.

The logical conclusion with respect to the latter of the above deductions is, of course, that there is present insufficient lime to precipitate all of the sugar from the "cold wastes" containing the higher concentrations of sugar. This conclusion appears to be justified from the data plotted in Fig. 4.

The upper curve in this figure represents the relative precipitation of the sugar—per cent on total sugar in the cold waste—corresponding to the "cold wastes" treated as indicated on the abscissa. This curve indicates the same relation as was shown by the curves in Fig. 3 in that the percentage precipitation falls off as the sugar concentration in the cold waste increases.

In obtaining the curve representing the CaO available in cold waste for sugar precipitation the alkalinity of the hot waste resulting from the experiment was substracted from the alkalinity of the cold waste treated, both figures being expressed as CaO. This is justified on the basis that the alkalinity of the hot waste is a constant for a given molasses and for a given method of cold process operation regardless of the concentration of either sugar or alkalinity in the cold waste or the sugar content of the resulting hot waste. Thus the alkalinity of the cold waste is composed of a constant quantity of alkali, probably a mixture of potassium, sodium and calcium that is not available for sugar precipitation and a variable quantity of lime that is available for sugar precipitation. The correlation between this curve and that for the per cent sugar precipitated is obvious.

TABLE I

Sugar in Cold Waste (Per Cent on Solution)	—Available CaO in Cold Waste—Per Cent on Solution— Total	Combined as Sesqui-Saccb. (Calc.)	Difference Total—Combined With Sugar
0.47	0.37	0.12	0.25
0.52	0.39	0.13	0.26
0.62	0.42	0.16	0.26
0.78	0.46	0.20	0.26
0.88	0.48	0.22	0.26
0.94	0.49	0.24	0.25
1.04	0.51	0.26	0.25

A further analysis of these data indicates that this variable quantity of available lime may be a function of two factors present in the "cold waste" solution. In Table I the figures in column 1 represent the per cent of sugar in various "cold waste" solutions produced from a given molasses. In column 2 is given the available CaO—per cent on solution—present in each of the solutions. Now there are available data that indicate that the sugar in any "cold waste" is combined with lime to form a soluble compound having a probable composition $3CaO.2C_{12}H_{22}O_{11}$. Calculations on this basis indicate that the quantity of lime combined with sugar in the various cold wastes tabulated is as listed in column 3. Thus in the waste that contained 0.47 per cent sugar, 0.12 per cent CaO of the total available (0.37 per cent) CaO in solution was probably combined with sugar. By difference, in column 4, this leaves 0.25 per cent CaO (on solution) to be supplied from some other source within the solution. Now it is interesting to note that the lime from this second source within the cold waste is apparently a constant and independent of the sugar concentration. Thus it would appear to be a possible function of some impurity present which very obligingly carries lime in a chemically combined form from the cold process into the hot, where it releases it for sugar precipitation. Again,

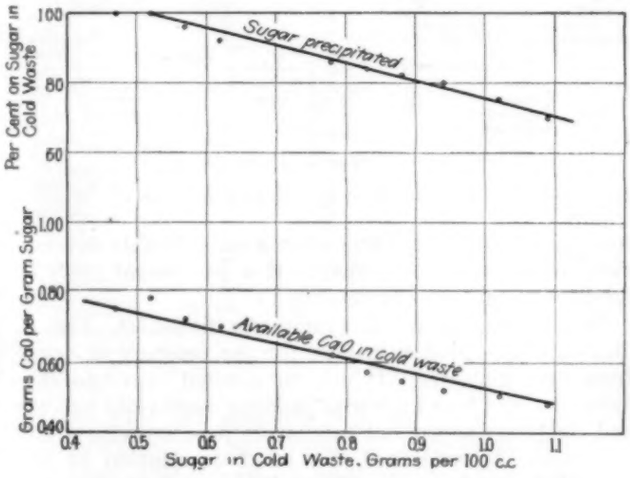


Fig. 4—Relation of "Available CaO" in "Cold Waste" to Sugar Precipitated

it may be partly due to the lower solubility of lime in aqueous solution at higher temperatures.

The commercial existence of the hot saccharate process depends upon its ability to recover the last 10 to 15 per cent of the sugar introduced into the Steffen process more economically than is possible with the cold process alone. The principal items of cost in its operation have been:

First—Filter fabric for the separation step.

Second—Steam for the precipitation step.

Third—Labor.

The life of cotton filter fabric in this service is limited to approximately 24 hours operation. Deterioration, resulting from the action of the hot alkaline solution, causes a marked decrease in the tensile strength, together with a hardening of the cloth. As a result the consumption of cloth, when plate-and-frame filters are used, is often as much as 30 to 35 sq.ft. per ton of molasses worked. This excessive cost has been the cause for considerable effort toward supplanting this type of filter.

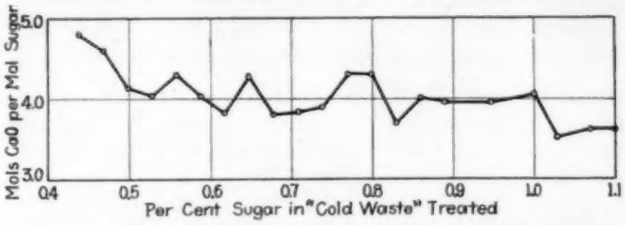


Fig. 5—Ratio of Mols CaO to Mol Sugar in Hot Saccharate Precipitate Obtained From Various Cold Wastes

One attempt in this direction has been based on employing the Vallez pressure filter, which permits the use of metallic filtering mediums. The character of the precipitate, however, had been such as to render necessary the employment of some filter aid such as kieselguhr. This is usually applied as a coating to the metallic cloth before the precipitate is introduced into the filter.

Another line of attack is based on the use of the Dorr tray thickener and the rotary vacuum filter. With this equipment something between 50 and 75 per cent of the waste is separated from the precipitate by decantation and the remainder sent to the filter in the thickened sludge. It is necessary to insulate the thickener tank to avoid heat losses and to steam jacket the tank of the filter for a like purpose. Cotton fabric is employed as filtering medium, and while its life is still limited to approximately 24 hours, the cloth consumption is approximately 1.5 sq.ft. per ton of molasses worked, or 5 per cent of that required for the plate-and-frame filters. Of these three installations the last, of course, requires the least operating labor.

In connection with hot saccharate filtration it would seem that continuous operation, such as is provided by the latter equipment, is preferable to the intermittent procedure necessary with the two previous types on the basis of improved temperature control. As mentioned previously, the precipitate decomposes if it is allowed to cool and the thickener-vacuum filter combination appears more foolproof against temperature fluctuations.

It is subject, however, to two difficulties. Variations in the physical character of the precipitate affect both units to a greater extent than in the case of the pressure filters. Also, a considerable quantity of foam is sometimes discharged from the precipitation tanks, and this accumulates on the surface of the thickener unless provision is made for its removal. This latter is probably more of an eyesore than an economic disadvantage. It seems to follow the incorporation of air into the cold waste en route to the hot saccharate process, and where means for permitting the escape of this gas is available, gives little trouble.

Overcoming a Filtration Difficulty

The variable physical characteristics of the precipitate, however, was economically menacing, since it caused a definite loss of precipitate with the decanted solution from the thickener. This has been solved by incorporating an idea, new to the process, into a new precipitation unit. With this unit it has been possible to produce not only a more uniform product but also a product that settled more rapidly and filtered more easily than the previously obtained precipitates.

As commercially applied during the 1923-24 campaign, the process consists of diluting one volume of cold waste with approximately 40 volumes of hot waste that is practically free from precipitatable substance but which has not been separated from the saccharate precipitated from it. The introduction of the comparatively small amount of the cold solution into the large volume of the hot is, of course, accompanied by a relatively rapid rise in the temperature of the former.

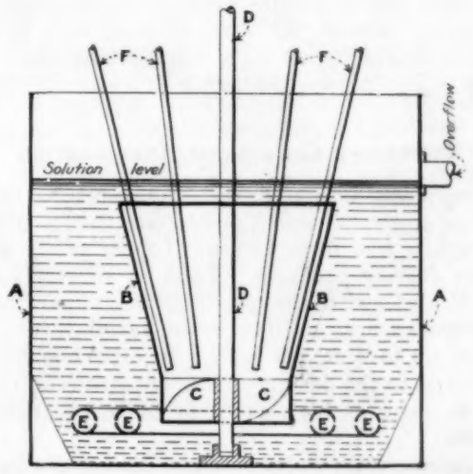


Fig. 6—Sketch of Hot Saccharate Precipitation Tank

Unless diffusion or mixing of the two is assisted by mechanical means this feature may defeat the object of the process. Thus it becomes advisable to effect the mixture in a zone of mechanical agitation, and when this is done the desired results may be obtained. The presence of the precipitate in the diluting solution assists in keeping down the number of new precipitate nuclei formed, once the mixture has been effected.

As to the apparatus employed,[1] Fig. 6 illustrates that operated in four factories last year. It consists of a cylindrical tank *A*, in which is installed a central well *B*. A four-bladed propeller of the ship type *C* is mounted on a vertical shaft *D* in the position shown inside and at the bottom of the well. Both the well and the annular space between the well and tank walls are baffled so as to prevent swirling. Thus a definite

[1]Author's Note: Apparatus described herewith is protected by United States patent.

path of travel is provided for the tank contents with a downward direction inside the well and upward through the annular space. Perforated steam coils *E* were installed near the bottom of the annular space so that heating might be effected in this zone.

Thus there is created a stream of tank contents down the central well carrying a fairly definite volume per minute which may be used as a dilutant, if sufficient time for precipitation is provided in the annular space. Under these conditions approximately 30 seconds is sufficient for this purpose. This requires that the tank provide for a content of approximately 20 cu.ft. for each cubic foot of cold waste fed per minute if a dilution of 40 to 1 is to be used.

The feed was introduced into the stream passing down the central well through a number of pipes *F* extending to a point approximately 6 in. above the propeller that provided the localized agitation zone desired for the thorough and immediate mixing. The propeller sizes were such that 40 to 50 r.p.m. produced the required circulation. Those familiar with the precipitation of hot saccharate will recognize that because of the scale formed on these feed pipes little heating of the feed occurred while it was passing through them. The tank discharged continuously by overflowing at the top of the annular space.

The admission of steam was controlled automatically and, with the exception of cleaning the regulator bulb at regular intervals to remove the scale formed thereon, the system required little attention. Obviously it is desirable to control the rate of feed, and this was effectively accomplished by a storage tank from which the cold waste passed through a set valve to the feed pipes.

Results of Commercial Installation

As previously indicated, one of the results expected from this apparatus was a precipitate that would settle more rapidly and filter and wash more freely as compared to former products. Tests at several factories had indicated, with the precipitation apparatus used in previous years, settling rates varying from 9 in. per hour up to 4 ft. per hour. In experimental work, preliminary to the design of this apparatus in its present form, rates as high as 20 to 24 ft. per hour were obtained.

The commercial results obtained during the last campaign, in the case of two factories using the new equipment, indicated a settling rate of approximately 10 to 12 ft. per hour. Individual tests, made on precipitate formed during periods when a thoroughly satisfactory temperature and feed control were operating, gave results in excess of 15 ft. per hour. In the third factory an average settling rate of 7.5 ft. per hour was indicated, while in the fourth the rate was approximately 5 ft. per hour. At present the cause for the lower figures obtained at the last two of the above is not apparent, although it may be a function of feed and temperature control. This increase in settling rate was accompanied by the anticipated improvement in filtration. In the case of the first two factories above mentioned, approximately 66 per cent of the area previously used was required to filter the precipitate from the improved process.

The data included in Table II cover comparative results for a group (No. 1) of three factories that operated old type precipitation plants and a group (No. 2) of four others in which the new system was operated during the 1923-24 campaign. We have also given the results obtained by these groups in 1922-23 before any new installations were made.

The apparent purity of a saccharate cake may be defined as the ratio of polarizing substances to the total dry substance present in a solution resulting from the decomposition of suspended saccharate by means of carbon dioxide, forming insoluble calcium carbonate, which is filtered off. In other words, this is approximately the apparent purity of the solution that is finally introduced into the crystallization process for the production of granulated sugar.

Table II

	Apparent Purity of Hot Saccharate Cake	
Operating Period	Group I Per Cent	Group II Per Cent
1922-23 Campaign	86.7	87.3
1923-24 Campaign	89.8	92.5

Where factories are operating on molasses similar with respect to the relative quantities of polarizing substances other than sucrose, it may be accepted as a relative measure of the extent of cake washing. Thus the difference between the results obtained by the first group and that by the second group during the 1923-24 campaign may be attributed to improved washing of the cake made possible by improved physical characteristics of the precipitate. This difference, amounting to 2.7 per cent in the instance named, would probably increase the amount of granulated sugar recoverable from the precipitate by approximately 5 per cent. A comparison of the second group of factories for the two campaigns 1922-23 and 1923-24 shows a rise of 5.2 per cent in apparent purity, but Group I also shows a rise of 3.1 per cent. How much of this rise obtained by Group I was due to variations in molasses characteristics during the 2 years and how much to increased superintendance induced by high results being obtained by the neighboring factory is, of course, a debatable question.

Reducing Steam Costs

As to efforts toward reducing the cost of steam required by the process, space does not permit of a detailed account of the various lines of attack that have been employed. In general, however, these have been directed toward the employment of vapor from one or another of the multiple effect evaporator bodies used in concentrating the beet thin juices. Scaling of heating surfaces, where indirect application has been attempted, is the usual cause for failure. Where direct application was employed scaling and—as we see it now—a lack of control probably caused most of the difficulties. In the apparatus described above most of the heating is accomplished by vapor from the first body of the juice evaporators, which usually operates at approximately 6 to 8 lb. pressure. This was supplemented by exhaust steam, at approximately 15 lb. pressure, which was automatically introduced when for any reason the vapor failed to hold the tank contents at the desired temperature.

In concluding, it may be said that the data incorporated herein present many unfinished aspects. Presentation at this time, however, appeared justified because of the void in the literature relative to the hot saccharate process.

What the Beet-Sugar Industry Has Learned About Filtration

Operating Practice and the Trend of Recent Developments in the Modern Plant Reveal Progressive Attitude Toward Industry's Outstanding Chemical Engineering Problem

By Joseph Maudru

Assistant to the General Superintendent, Great Western Sugar Co., Denver, Colo.

BEET SUGAR is separated by crystallization from liquors that have been partly freed of the non-sugars with which it is grown. The raw part of the process is largely concerned with the separation of the impure sugar juices from the plant structure and with the purification of these juices to the highest point possible. The finishing part of the process is concerned with the exhaustion, by crystallization, of the mother liquors to as low a degree as possible. The attainable spread between the highest point to which the juices can be purified, on the one hand, and the lowest attainable point to which the final sirups can be exhausted, on the other hand, is a measure of the performance of the total operation. With this view in mind, filtration as a specific means of purification is a very important subject. In a single-process factory—that is, one with no process for the recovery of sugar from final molasses—the juices and sirups are subjected to no less than six successive filtrations. After each operation on the juices, such as carbonation, sulphitation, concentration, etc., comes a filtration. These filtrations may be conveniently divided into two classes: (*a*) The separation of quantity suspension. (*b*) Clarification or the removal of very light suspension.

This paper will consider only that part dealing with the separation of solids that occur in generous amounts. Probably the most important filtration operation in the production of beet sugar is that occurring at the so-called first carbonation filters. To these filters comes a slurry equivalent in weight to about 150 per cent on beets, containing about 11 per cent solids in solution and 3 to 4 per cent solids in suspension, having a total alkalinity of 0.10 gram CaO per 100 cc. and a temperature of 90 deg. C. This juice is the raw juice from the beet, heated, treated with quicklime and carbonated to the point named, in a batch treatment. Slight, almost imperceptible, variations in the character of the precipitate may be introduced because of the batch operation. Re-solution of some of the precipitated beet non-sugars is likely to occur if there is delay between carbonation and filtration, and this seriously affects the quality of the crystallized product. For the best results the filtration must be rapid and complete.

At the time of the wide development of the beet-sugar industry in this country, which occurred about 1900, the common type plate-and-frame filter was installed for this service. Although various attempts at improving upon the plate-and-frame equipment have been made, no ultimate apparatus has yet been brought forward. Some of the later developments have advantages, but usually at the expense of some desirable feature. As a result of this lack of development of a filter that shows advantage in each respect the beet sugar operators have been slow to abandon the old plate-and-frame installations, waiting for a filter that combines at once low maintenance, low labor cost, low cloth consumption and low losses. One large company still handles more than 60 per cent of its tonnage through plate-and-frame presses. (See Fig. 1.)

Presented at the Denver meeting of the American Institute of Chemical Engineers, July, 1924.

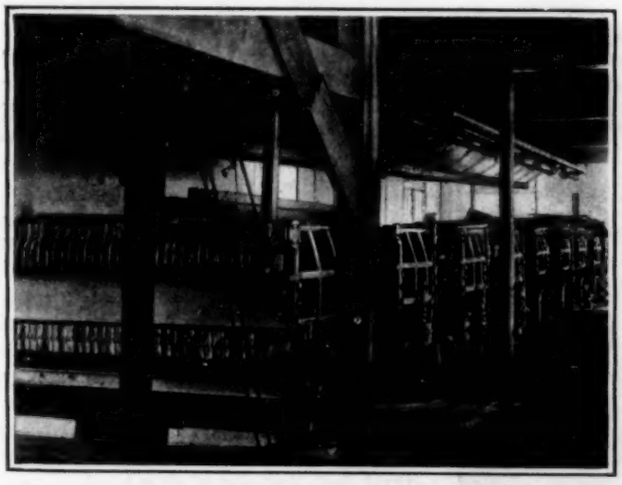


Fig. 1—A Typical Installation of Plate-and-Frame Filter Presses Used in a Large Beet-Sugar Plant for First Carbonation Filtration

First Carbonation Filters

Experimentation and trial, however, have not been at a standstill. Among the newer type filters used for first carbonation a number may be mentioned.

The Kelly Filter. This filter consists of a horizontal cylindrical pressure shell, having one end open and the closed end dished. The cast-iron head that closes the shell is integral with the filter carriage, which holds in position the filter leaves. The inside end of the filter carriage rolls on wheels on a track within the shell and the head end on wheels on a track outside the shell. The carriage passes into the shell and the front head closes the front end of the shell. The leaves are made of iron pipe and heavy woven wire. They are rectangular, of the same length but of varying widths, and are fastened to the head by pipe unions and nipples. The filtrate passes through these connections, through the head and out of the press. The dressing for the leaves comes in made-up bags, which are slipped over the leaf frames and securely sewed. The cycle consists of building cake, washing cake and removing cake,

which is done by unlocking the closing mechanism and rolling the filter carriage out of the shell. The cake is removed by an operator with a hose having a long nozzle delivering a jet of water.

It is important to build a sufficiently thick cake in order to get capacity from the installation. Usual thickness varies from ½ to 1 in.

Between the operations of filling and washing and between washing and removing cake, the shell is drained. In the meantime cakes are held in their vertical positions by air at about 5 lb. pressure, admitted automatically whenever pressure conditions within the shell demand. The handling of these "excess solutions" requires suitable tanks and pumps. During the filling and washing portions of the cycle it is also important to have a sufficient and constant supply of air in order to prevent the cake from falling from the frames during a momentary interruption of supply.

A typical installation of Kelly filters for first carbonation filtration is shown in Fig. 2.

The Kelly filter has considerable advantage over the plate-and-frame filter in the items of labor and cloth and in the fact that it has only one joint to maintain, but loses this advantage in the item of values left in the cake and in the quantity of wash water required.

Theoretically the Kelly leaf should lend itself to easy washing, when it is considered that the cake when finished should have equivalent permeability over its surface. Also the flow of wash water through the cake is in the same direction as that which the liquor took when the cake was built, consequently there is no derangement of the structure of the cake during washing. In actual operation, with the equipment in good working order and with careful handling, no cakes ordinarily drop from the cloth. The one possibility, however, that is always present is the shrinkage cracks occasioned by the air drying of the cake during the process of draining the shell of excess juice before washing. When this happens, the area surrounding the shrinkage cracks will take a larger proportion of the wash water than is necessary and other areas will not have sufficient water. A possible remedy—though a makeshift—for such a condition and to my knowledge one that has not been tried, would lie in adding to the wash water a certain proportion of spent cake or kieselguhr to fill up the cracks.

The Vallez Filter. One trial installation was made of the Vallez filter on first carbonation service. The Vallez filter consists of a cylindrical horizontal pressure shell having a scroll at the bottom for the delivery of cake through a suitable opening. The shell is split on the horizontal diameter, flanged and bolted. Through the center is a hollow revolving shaft carrying circular leaves of woven wire covered with cloth, regularly spaced on the shaft and ported to allow filtrate to pass from the leaves into the hollow shaft, thence out of the filter.

The filter is intermittent in operation, the cycle being similar to that of the Kelly. The cake is discharged by opening the bottom door, starting the scroll and removing the cake by water jets introduced through doors provided for the purpose and situated in a horizontal line in the top half of the shell.

Much difficulty was experienced with broken cloth and in discovering which cloth was broken. The renewal of a broken cloth is an arduous task necessitating the removal of the top half of the shell, removal of shaft and subsequently the disks from one end of the shaft until the disk giving trouble is encountered. These filters were abandoned for first carbonation service, but were equipped with Monel metal cloth and put into the hot saccharate service. This hot saccharate solution is so caustic as to require renewal of a cotton cloth every 24 hours, and this consideration makes the Monel-equipped Vallez a fairly good filter for hot saccharate filtration.

The Sweetland Filter. This equipment is used in a limited way for first carbonation service, but the writer has no intimate experience with its operation. The filter consists of a horizontal cast-iron pressure cylinder, split horizontally and the lower half hinged to swing open for the discharge of cake. The leaves are circular and stationary, each having a connection at the top through the shell by a nipple having washers and nut. The nipple serves the double purpose of fastening the leaf to the shell and of providing an outlet for the filtrate to the outlet header outside the filter. Each leaf has a cock on the discharge for shut off in case of cloudy filtrate, which can be observed through glass tubes through which each leaf discharges.

The operation is considerably like that of a Kelly filter and it has the advantage over the Kelly of having less unoccupied volume to produce "excesses." It has advantage over the Vallez in that cloudy leaves are more easily detected and more easily removed and changed. All of the types considered heretofore have the common objective of being intermittent in operation, which necessarily influences cost of installation and cost of operation.

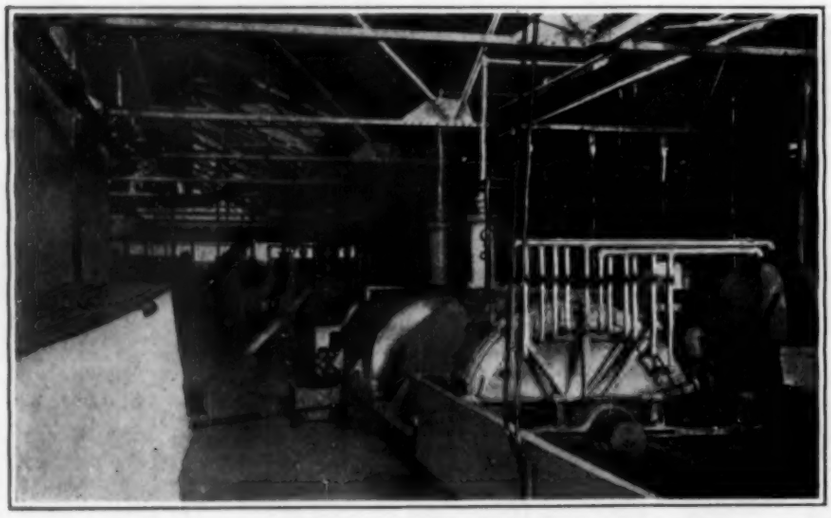


Fig. 2—Kelly Filters Installed for First Carbonation Filtration

With the present knowledge and experience of filtering first carbonation slurry, I believe it is safe to say that the best thought tends toward the use of a thickener and the handling of the thickened sludge over a rotary vacuum filter. This combination of apparatus seems to answer most fully the requirements of low labor and cloth costs and low losses. Following are the results of some trial installations of this kind:

The Dorr Thickener. A trial installation of the Dorr thickener fol-

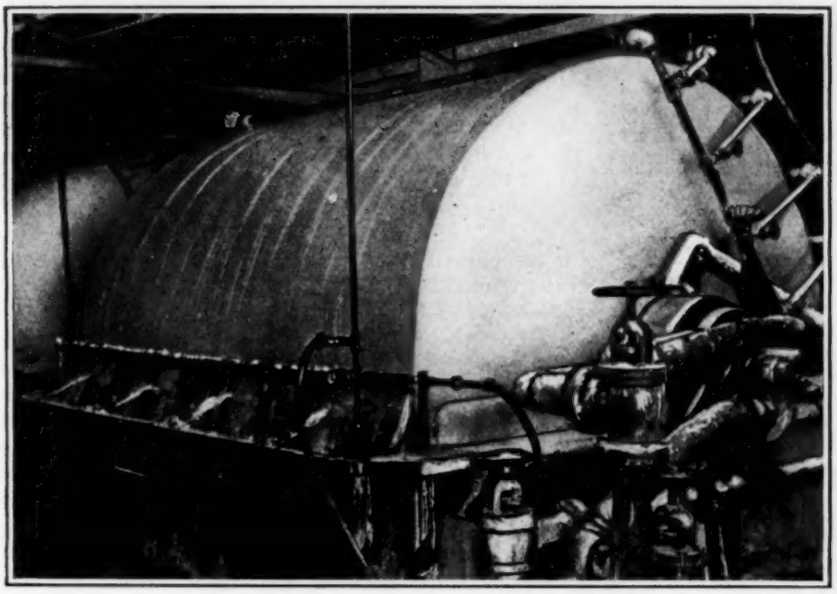


Fig. 3—Portland Filter Following Kelly Filter Used as a Thickener

lowed by a rotary vacuum filter, having a capacity equivalent to about one-fifth of that required for one factory was installed and operated for a period of 38 days.

The rotary vacuum filter consists of a cylinder rotating on a horizontal axis, with the lower portion of the cylinder submerged in a tank containing the slurry to be filtered. The surface of the cylinder is divided into sections, the dividing partition being parallel to the shaft. The cylinder surface is covered with permanently installed screen, over which is a cloth filtering medium. The total surface is covered with one piece of cloth, yet each section is independent in operation from the next. The cloth is held in position with wire winding. Each section is connected with pipes to a rotary valve situated on the shaft at one end of the cylinder. This valve controls the vacuum for forming the cake and washing it and for withdrawal of the filtrate and wash solution and in turn controls the air pressure used for removing the cake. A scraper extending across the face of the press and resting on the wire winding removes the cake after it has been loosened with air. On the face of it this combination—thickener and vacuum filter—presents promising possibilities, but it was found impossible to insure a clear sparkling overflow. It was found that best results were obtained when carbonation was allowed to proceed to a decided break—that is, to a comparatively low alkalinity. At this point the settling rate was from 3 ft. to 3 ft. 6 in. per hour. Considerable trouble was experienced with gas that collected under the tray and finally found its way out with the overflow, causing considerable agitation of the liquor within the apparatus and disturbing the settling conditions, thus resulting in cloudy juices. It was thought at the time of the experiment that a change of design might correct this difficulty, but this was never accomplished. The cloudy juice seemed not to influence purity appreciably, but the juice was darker and its lime salt content was slightly increased. Since the character of the precipitate that was fed to the Dorr thickener was such that it would not deliver a bright overflow and this specification is now considered essential, the idea was abandoned.

Use of Filter as Thickener Followed by Rotary Vacuum. A commercial size of the combination of Kelly filter and rotary vacuum has been in successful operation for 4 years and shows considerable advantage in all directions. (See Fig. 3.) The operation consists in building a cake as ordinarily in the Kelly filter, draining off the excess juice, dropping the unwashed caking, repulping to about 25 per cent suspended solids and dewatering in a battery of rotary filters on which the cake is washed. Filtrate from this operation furnishes water for repulping the Kelly cake. The number of square feet of filtering area is rather high per unit output with this arrangement, but costs of the essentials—labor, cloth and losses—show advantageously.

The Oliver-Borden Thickener. Last year an installation of this type was made and operated for 30 days. In size it was equivalent to about one-seventh of the requirement for one factory.

As will be observed from Fig. 4, this thickener consists of a steel tank, open at the top, having a rectangular cross-section and V-shaped bottom equipped with a scroll mixer-conveyor. Suspended in this tank vertically are stationary tapered steel tubes 9½ in. in diameter at the top and 8¼ in. in diameter at the bottom, 6 ft. 8 in. long. The tubes are perforated with ¼-in. holes, ⅜-in. centers and inside of each tube is another tube 6 in. in diameter by 12 in. long with solid surface. The perforated tubes are covered with cloth stockings, wrapped with wire and have 16 sq.ft. filter surface. The tubes are arranged in groups of four each. Each group is served with a 2-in. pipe, branching to four 1½-in. pipes, one to each of the group, the other end of the 2-in. pipe being connected to the regular Oliver filter valve mechanism that automatically and periodically produces inside of the tubes vacuum, atmospheric or pressure conditions.

In operation, the tank is filled with slurry submerging the tubes and the vacuum produces a cake and clear juice. Momentary breaking of the vacuum and application of pressure blows off the collected cake, which gathers in the V-shaped bottom of the apparatus from which the thickened sludge is removed by a diaphragm pump for further separation and washing on a vacuum drum.

The cycle, as operated in this experiment, was 10.5 minutes and obviously the last portion of the suction period must have been through an appreciable thickness of cake and the flow through the accumulating cake must have been at a gradually decreasing rate as the end of the suction period was approached. If these observations are correct and if the outlet conduits are sufficiently large to carry the filtrate when the cake is very thin, then they are larger than necessary near the end of the suction cycle; consequently the average rate of flow through the cloth must be less than the capacity of the outlet pipes. The capacity per unit filter area might be increased by more frequently alternating suction and blowback.

Thickened sludge showed about 13 per cent solids, the filtrate was clear, labor and cloth low and indica-

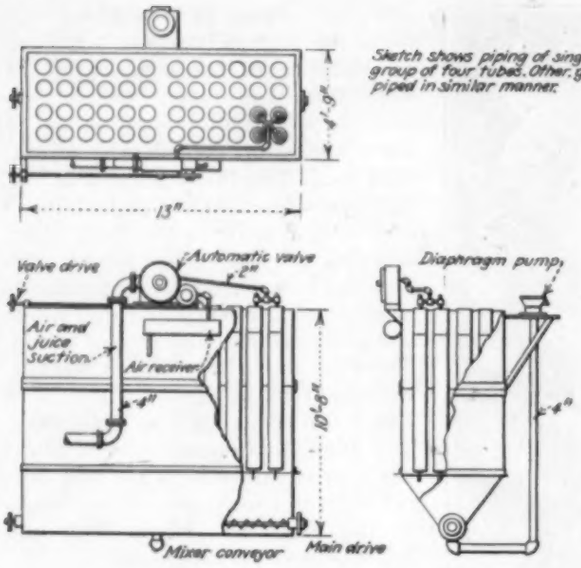


Fig. 4—Sketch Showing Principal Features of Oliver-Borden Thickener

tions point to low losses. Capacity indications show 0.98 ton beets per 24 hours per sq.ft. filter area.

The Genter Thickener. This equipment, which is in the process of development, operates on the same principle as the Oliver-Bordon described just above, except that it uses a hydrostatic blowback instead of air. A sketch of the Genter thickener is shown in Fig. 5. The thickener consists of two tanks, one within the other. The smaller central tank has closed ends and forms the vacuum receiver. The annular space between the central tank and the outside tank forms the thickening chamber, which is divided into eight sector-shaped smaller compartments or units by means of walls that radiate from the receiver. Tubes having 5.75 sq.ft. area are in groups of four, each group connected to a central rotating valve, which periodically allows a vacuum condition within the tube to be alternated with a liquor blowback. The timing arrangement is easily adjusted and the writer is advised that the results here referred to were obtained with a suction period as short as 30 seconds. The tubes are of wood, covered with cloth sacks not wound, have an outlet connection at the bottom and are held in the tube frame under the tension of a coil spring.

Large claims for capacity are made for the Genter vacuum thickener. The machine is said to have shown capacities equivalent to 2 to 3 tons beets per sq.ft. filter area per 24 hours. The large capacities are said to be due to the fact that the filtrate travel and hydrostatic blowback travel from the timing valve are short and equidistant and therefore instantaneous in all groups of frames. Also the vacuum is always immediately active and effective when filtration starts. It is further claimed that this large capacity is due to the frequent hydrostatic blowback, which minimizes the formation of vapor space within the tubes and conduits at the working temperature. Under these conditions it is held that the conduits are carrying practically solid columns of liquor rather than only successive pistons of liquor.

For comparative purposes operating data on some of the filters actually installed for first carbonation service are presented in Table I.

I have omitted giving any data on quantity of wash water required to wash the cake produced by these various filters, on account of the unreliable figures usually given by a hot water meter in constant use. The water necessary to reduce the losses to the figures shown ranges from 120 to 160 per cent and up on wet cake. These residual values in first carbonation cakes may appear high, especially to metallurgical men, but it must be remembered that any further reduction necessitates more dilution and there comes a point where the sugar loss must be compared with the cost of coal and equipment for recovery of the sugar by evaporation.

Saccharate Filtration

Let us pass now to another large filtration problem of the beet-sugar industry, that of cold saccharate filtration in the process devised by Steffen for the recovery of sugar from molasses. The filtration problem consists in separating and washing the insoluble sucrate from the remaining liquid, which is waste. The slurry contains about 12 per cent solids and has a tendency to foam on account of included air introduced during its previous violent agitation. The concentration of suspended solids is high enough for direct handling by vacuum filters without thickening. The sucrate is slightly soluble and is comparatively unstable, making it desirable to effect the separation quickly. There are about 11 tons of slurry per ton of molasses worked. The resulting cake contains 60 per cent water and amounts to 300 per cent on original molasses. Wash water varies from 90 to 225 per cent on cake.

As in the case of the first carbonation filtration, as much as 60 per cent of the molasses worked in the Steffen process is handled with the old plate-and-frame presses. These presses are large, taking a 40-in. cloth, having a 2-in. cake frame and 1,100 sq.ft. per press. The labor is arduous, and at times it is difficult to obtain workmen for this kind of labor. The waste solution and the recovered cake are sufficiently caustic with lime as to require workmen to exercise considerable care in order to prevent severe burns. Notwithstanding these disadvantages of the plate-and-frame

Table I—Comparison of Various Types of Filters Actually Installed for First Carbonation Filtration Service

Equipment and Rated Beet Capacity	Plate & Frame Non-Steffen 2.07 CaO on Beets 1,436 Tons Beets 24 Hr.	Proposed Oliver-Borden Thickener & Rotary Vacuum	Kelly Non-Steffen 2.17 CaO on Beets 1,640 Tons Beets 24 Hr.	Kelly Thickener Rotary Vac. Non-Steffen 2.18 CaO on Beets. 1,633 Tons Beets 24 Hr.	Kelly Steffen 3.24 CaO on Beets 2,604 Tons Beets 24 Hr.	Plate & Frame Steffen 3.36 CaO on Beets 2,720 Tons Beets 24 Hr.
Draft	142	142*	161	147	146	146
Tons juice passing 1st presses 24 hours	2,039	2,039	2,640	2,400	4,227	4,466
Tons wet cake at 1st presses 24 hours	145	145	182	185	402	421
Sq.ft. filter surface	3,556	3,246	4,900	4,500	6,623	11,844
Tons wet cake per 24 hours per sq.ft. filter surface	0.0408	0.0447	0.0372	0.0411	0.0607	0.0355
Tons juice per 24 hours per sq.ft. filter area	0.573	0.628	0.539	0.533	0.638	0.377
Operating labor cost per ton wet cake	$0.55	$0.17	$0.22	$0.22	$0.18	$0.34
Cloth cost per ton wet cake	$0.28	$0.04	$0.07	$0.06	$0.07	$0.26
Pounds sugar per ton wet cake	15	9	20	9	22	18

* Estimated.

filters, they have endured against newer installations of rotary vacuum filters, etc., and this largely on account of the lesser loss shown by the plate-and-frame equipment. On the average, losses are greater on the vacuum filters than on plate and frame to an extent equivalent to 2 per cent of the total sugar entering the process.

There are several reasons for this difference. The vacuum filter picks up a ¾-in. cake, which is washed with 100 per cent water on cake. To date we have not been able definitely to separate the resulting wash solutions from the original filtrate in a satisfactory manner. Just why this condition exists is not known. Suspicion points to the probability that air locking occurs in the filtrate discharge passages, which prevents them from draining completely and thus causes a mixing of filtrate with wash solutions in these spaces. On the other hand, the plate-and-frame press with a 2-in. cake washes with 125 to 250 per cent water on cake, but the separation of the wash water from the waste water is fairly complete. Wash solution contains a small percentage of sugar, and as the quantity of the wash water is increased the proportion of sugar to non-sugar is increased. If separated from the waste water, the wash solution has a valuable use for the dilution of the original molasses, which not only conserves on quantity of water used and quantity of water discarded as waste but coincidentally saves sugar.

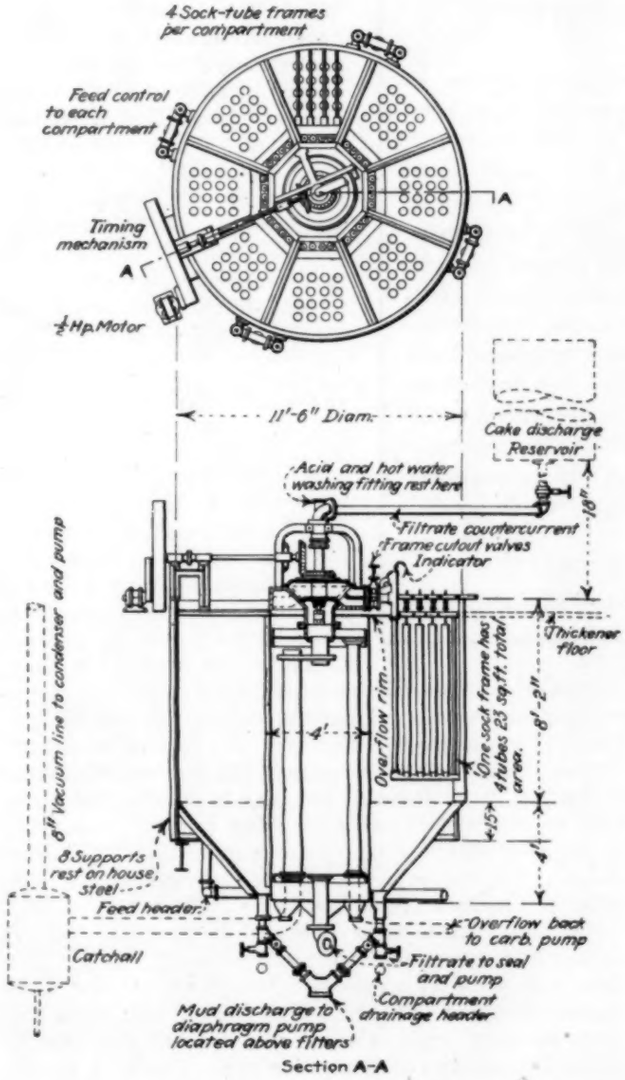


Fig. 5—Sketch Showing Principal Features of Genter Thickener

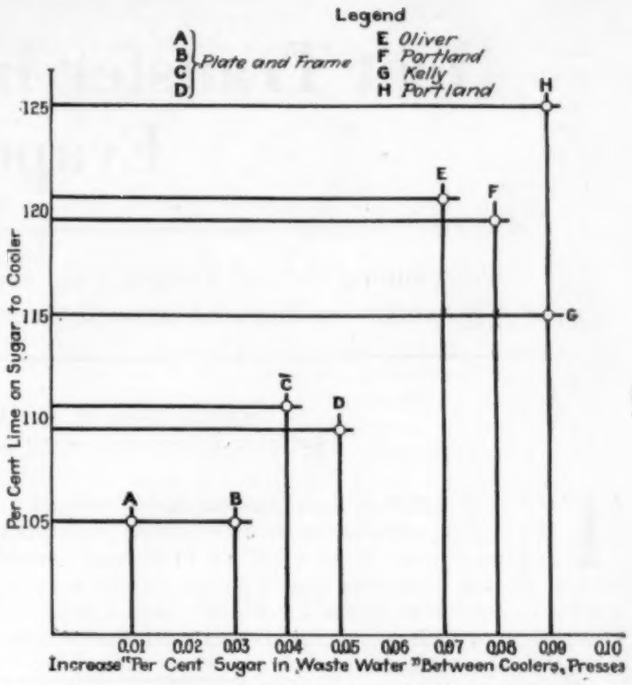


Fig. 6—Comparing Different Types of Filter on Cold Saccharate Under Varying Operating Conditions

Another fruitful source of loss in operating a vacuum filter on cold saccharate is the necessity for maintaining an overflow from the filter immersion tank to free the contained slurry of foam. Although this overflow contains fewer suspended solids than the feed, the longer time of contact between solids and solution tends to cause re-solution of the precipitated saccharate, thus increasing losses. In the installations which show an excessive re-solution there usually appears a slightly higher lime addition. Work is now being done to determine whether this condition is a function of the type of press, of the lime or of some other detail of operation. The point may be more clearly brought out by consideration of the graph in Fig. 6.

The American filter has been tried on cold saccharate with only limited success. The principle of the American is on the order of the Oliver and Portland, except that instead of having a cylindrical drum divided into compartments to carry the filtering medium there are a number of vertical disks on a rotating shaft which carry the cloth. This apparatus on cold saccharate service developed excessive foam troubles; it was difficult to keep the cloth cleaned on account of inaccessibility, and the fact that the scrapers used to remove the washed cake plastered the precipitate into the pores of the cloth. It was found difficult to wash a vertical cake with sprays. In general the filter required too much attention to attain much success in sugar work, although large presses of this type are successfully used on ore slimes.

In conclusion, present indications point to the more extended use of the rotary vacuum drum type filter for cold sacharate work, especially if some remedy can be found to correct high-loss and high-lime-addition characteristics now existing. As noted before, the trend of thought for betterment of the first carbonation filtration lies in the direction of a suitable thickener followed by a continuous vacuum filter.

Heat Transfer in Steam-Jacketed Evaporators

Determining Overall Transmission and Film Coefficients as Well as Operating Efficiencies on Plant Equipment Over a Wide Range of Industrial Conditions

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THE importance of heat transfer in its relation to the design and operation of chemical apparatus and machinery is so great as to furnish ample apology for the numerous papers on the subject appearing in the current technical literature. Indeed, in all the unit processes of chemical engineering, with the possible exception of crushing and grinding, heat transfer is either the primary objective or a more or less direct factor limiting the results obtained.

Among the most important contributions to the subject of heat exchange by conduction are the papers recently published by McAdams and Frost (*Ind. Eng. Chem.*, 1922, vol. 14, pp. 13 and 1101). In the case of flow between fluids separated by a boundary wall these authors express the familiar Newton's equation in the form

$$(1) \quad \frac{Q}{\theta} = \frac{\Delta t}{\frac{1}{h_1 A_1} + \frac{L}{k_2 A_2} + \frac{1}{h_3 A_3}} = \frac{\Delta t}{R} = H A_{av} \Delta t,$$

where Δt is the overall temperature gradient, H the overall coefficient of heat conductivity and h_1, k_2 and h_3 the specific conductivities of the first fluid film, the boundary wall and the second film respectively. They deprecate the fact that most transmission data are expressed as overall coefficients and stress the importance of developing and tabulating general equations for the film coefficients for the guidance of the designer who by substituting these values in equation (1) may thereby calculate the overall coefficient and the areas of heating surfaces necessary for a given capacity under given conditions. On the basis of their own experimental results together with the rather meager data on the direct measurement of film coefficients to be found in the literature they propose as the formula for liquid film conductivity in the case of heat transfer from condensing steam to liquid (that is not boiling), under forced convection through pipes,

$$(2) \quad h_L = 23.6 \frac{K}{D} \left(\frac{Du\rho}{z} \right) 0.796$$

where K is the specific conductivity of the liquid, u its velocity, ρ its density, z its specific viscosity and D the inside diameter of the pipe in inches. The mean straight line curve from which the preceding formula was deduced—the logarithmic graph $(h_L D)/K$ against $Du\rho/z$—conforms closely to the points as plotted in spite of the diversity of the experimental conditions under which the various data were obtained. The conductivities of the common metals are of course available and the coefficient k_2 for the boundary wall may be easily calculated. With unit areas, the overall coefficient is now

$$(3) \quad H = \frac{1}{\frac{1}{h_1} + \frac{L}{k_2} + \frac{1}{h_3}}$$

Without question this method of attacking the problem is thoroughly sound in principle; but whether it can replace entirely direct measurement of H is doubtful, for the experimental difficulties of evaluating some of the factors involved in a film coefficient formula may be great, as, for instance, determining the velocity of natural convection through the tubes of evaporators. Moreover, the task of constructing a "synthetic" H is complicated by the cleanliness factor, for it is obviously not easy to standardize a film that may consist of oxide, sulphide, mineral scale or oil of varying thickness, density or composition. The importance of this factor has lately been emphasized by Pridgeon and Badger (*Ind. Eng. Chem.*, 1924, vol. 16, p.468).

Lucke ("Engineering Thermodynamics," p. 533) is emphatic in advocating direct measurement. " . . . The practical everyday problem of deciding on how much surface to allow on a given heat flow or how much heat can flow past a given surface is not one that can be solved by the laws of conduction even if data on all substances were available, and probably never will be,

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HEAT TRANSFER

Several articles on heat transfer in evaporators and condensers have been published in *Chem. & Met.* in recent months. These have been largely from the standpoint of theory and laboratory experiment or have applied to transfer through tubes. The present article, which details the results of tests on commercial-sized apparatus of the steam-jacket type, approaches the subject from a slightly different angle than have these previous articles. It is of interest to all concerned with heat transfer problems and of particular moment to the designers and users of steam-jacketed equipment.

A UNIT PROCESS OF CHEMICAL ENGINEERING

Read and discussed at the Denver meeting of the American Institute of Chemical Engineers, July, 1924.

because it requires a hypothesis fixing the thickness of the fluid film, the joint resistance, the kind and thickness of fouling or layer of dirt. Problems of this character are to be solved in another way by means of coefficients of transmission found by experiment and applied to the same kind of apparatus as that on which the experiment was made and covering all resistances together, although each cannot be separated from the rest."

As in most cases of difference of opinion the truth probably lies somewhere between the two extremes.

Steam Jacket Heating

Investigations of one of the many phases of heat transfer—viz., flow in steam-jacketed evaporators—have been carried on at the University of Iowa since 1921 and the material presented in this and subsequent papers is selected from theses presented by candidates for advanced degrees in chemical engineering. Selection of this type of apparatus for study was suggested by the meagerness of published data, for while vacuum evaporation involving heat transmission through tubes has been well covered by such authorities as Hausbrand, Kerr and Badger, little attention evidently has been given to the secondary but nevertheless important subject of steam jacket heating. Few data of any kind that can be used in design are available, much less complete information covering pans of various kinds of metal, wall thickness, shape and condition of surface.

In scope, the work already done and immediately projected comprises studies of open evaporating pans of (1) cast iron, (2) cast iron with enamel lining, (3) cast iron with lead lining, (4) copper and (5) aluminum. Besides these, tests are being made on a steam-jacketed copper vacuum pan and on a copper still operating at barometric pressure. The data desired are, first, overall transmission coefficients over as wide as possible a variety of conditions met with in industrial operation, together with such figures for film coefficients as may be evaluated, and second, operating efficiencies under the same specified conditions.

Among the variables taken into account are (1) temperature gradient, (2) hydrostatic head, (3) density of liquid, (4) viscosity of liquid, (5) velocity of convection currents as well as those produced by means of agitators, (6) radiation and (7) character of metal used in construction. The apparatus employed was in every case of experimental plant size and results are presented, therefore, with confidence so far as their application to plant conditions is concerned. Indeed, it has been our purpose so to reproduce normal plant operating conditions as to make the overall figures obtained generally significant over a wide range and thus to minimize the necessity for evaluating the more elusive film coefficients.

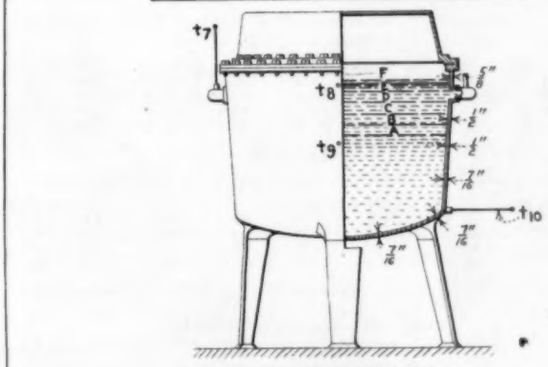
How the Tests Were Made

The first evaporator to be studied was a 47-gal. cast-iron kettle with 7-in. curb manufactured by the J. L. Mott Iron Works and listed in its catalog as Plate 11-X. For the later runs this was heavily insulated with Sil-O-Cel applied in three coats. Dimensions, including thickness of metal wall, are given in Fig. 1. Supplementary apparatus used in obtaining heat efficiencies as well as transmission data included a Schaeffer & Budenberg separating calorimeter for measuring the quality of the steam, a highly accurate test gage reading to 60 lb. made by the same company, a Worthington Type F duplex direct-acting water meter, calibrated mercury thermometers and tanks, condensers, steam traps, barometer and platform scales. The whole set-up is shown in detailed diagram in Fig. 2. Distilled water produced in ample amount by means of a double-effect evaporator which is a part of the laboratory equipment was used throughout the work. This was supplied to the kettle from an elevated tank mounted on platform scales, and maintained at constant level with the aid of a hook gage. A copper worm condenser cooled with accurately metered water was placed in series with the steam trap for the measurement of heat leaving in the condensate. Temperature gradients used in determining the coefficient were calculated as the difference between temperature corresponding to the indicated pressure of the steam and the boiling point of the evaporating water corresponding to the barometric pressure. From the heat balance made on each run the amount of heat transmitted, as well as that lost by radiation and discharged in the condensate, was determined and from this the coefficient and the transmission and overall efficients were calculated.

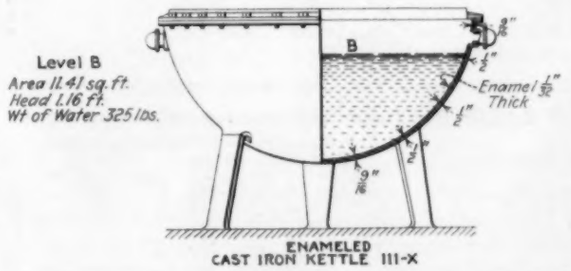
Heat Losses From Bare Kettles

In order to determine the loss of heat from the unlagged surface of the kettle a series of runs was made before the Sil-O-Cel coating mentioned above was applied. A tight-fitting wooden diaphragm was inserted at the junction of the curb and the steam jacket and covered with layers of paper and dry Sil-O-Cel to make it a non-conductor of heat. A dead-air space was thus provided within the kettle and radiation was necessarily confined to the kettle walls. The first series was run with static air conditions; in the second a draft induced by a 16-in. electric fan placed at a distance of 14 ft. was directed against the apparatus, the velocity at the sur-

Level	Area (Sq. Ft.)	Head (Ft.)	Wt. of Water (Lb.)
A	9.01	1.05	200
B	9.71	1.16	225
C	10.47	1.27	250
D	11.20	1.38	275
E	11.95	1.49	300
F	12.62	1.50	325



CAST IRON KETTLE 11-X



ENAMELED CAST IRON KETTLE 111-X

Fig. 1—Types of Kettles Tested

Table I—Radiation Losses From Bare Kettle Surfaces

Run No.	Absolute Steam Pressure	Steam Quality	Heat Transmitted B.t.u.	Temp. Grad. Deg. F.	*U* Steam to Air	Velocity of Air, Ft. per Min.
			Series II-A			
0	37.6	99.1	14,240	181.7	4.8	0
1	40.1	99.2	12,992	182.8	4.4	0
1a	40.0	98.7	14,500	185.1	4.8	0
3	50.4	99.2	14,590	196.8	4.6	0
3a	49.7	99.2	16,170	191.9	5.2	0
5	60.0	98.9	18,580	211.6	5.4	0
5a	60.0	99.4	17,940	208.1	5.3	0
7	69.8	99.6	18,980	217.8	5.4	0
7a	69.5	99.5	17,920	214.7	5.2	0
			Series IIIB			
3	50.2	99.6	20,190	198.4	6.3	254.0
3a	50.6	99.4	20,930	202.0	6.4	252.0
5	61.1	98.8	21,580	211.1	6.3	220.0
5a	60.5	99.2	21,640	208.6	6.4	239.0

Table II—Effect of Temperature Gradient and Hydrostatic Head

Run No.	Abs. Steam Press. Lb. per Sq.In.	Steam Quality Per Cent	Heat Transmitted B.t.u.	Overall Eff. Per Cent	Transmiss. Eff. Per Cent	Temp. Grad. Deg. F.	*U* Steam to Water	Water Evaporated Lb.
				Series III-A Head = 1.05 in.				
1	37.5	97.7	62,320	75.3	91.9	50.6	273	56.0
1a	38.9	96.9	65,340	62.0	94.4	54.1	268	59.0
2	43.9	96.9	73,090	79.1	94.9	60.4	269	66.0
2a	47.2	98.0	82,340	72.0	89.4	65.4	280	74.0
3	49.7	97.3	93,730	76.4	94.8	69.6	299	81.5
3a	49.8	97.9	82,670	69.3	88.1	70.4	261	78.0
4	53.1	98.5	92,570	75.6	87.6	73.4	280	80.5
5	58.8	97.2	101,520	69.4	86.6	79.4	284	100.0
				Series III-B Head = 1.16 in.				
1	39.4	97.0	.....	....	....	55.4	...	70.0
2	44.7	98.1	77,680	70.8	86.8	63.1	256	75.0
3	49.2	97.6	91,080	70.4	87.7	69.0	271	88.0
3a	49.9	97.4	94,380	73.1	92.0	70.6	275	89.0
4	54.3	98.1	94,420	67.6	84.5	75.3	258	93.0
5	59.0	97.8	102,670	66.7	84.8	80.6	265	101.0
5a	59.1	97.7	108,050	66.7	84.8	80.1	278	106.5
				Series III-C Head = 1.27 in.				
1	38.2	97.3	61,360	70.6	88.3	53.3	229	62.0
2	44.1	97.6	78,930	70.0	87.3	62.0	248	77.5
3	49.7	97.1	95,240	69.4	87.9	69.4	261	93.5
3a	49.7	97.3	96,160	70.8	89.1	70.1	262	90.5
4	54.0	97.7	100,840	67.5	85.3	74.6	258	98.0
				Series III-D Head = 1.38 in.				
1	39.7	97.8	83,360	70.3	85.4	55.2	230	70.5
2	44.6	97.9	82,290	66.3	82.0	61.7	238	81.5
3	50.0	98.1	106,050	74.2	92.9	70.5	269	105.0
3a	50.4	97.8	110,700	70.8	88.2	71.1	255	96.0
4	53.4	98.0	110,710	72.2	91.3	74.5	265	108.0
				Series III-E Head = 1.49 in.				
1	39.6	98.2	76,660	75.7	93.6	53.8	238	74.0
2	44.2	98.2	88,920	71.4	90.3	60.6	246	86.0
3	49.5	97.8	107,430	70.3	88.6	69.3	259	104.0
3a	50.5	97.7	105,990	71.3	88.7	71.3	249	100.5
4	54.2	98.4	115,150	72.0	91.9	75.8	246	111.5
				Series III-F Head = 1.59 in.				
1	39.6	98.3	79,220	73.7	91.7	55.3	227	77.0
2	43.3	97.5	92,020	71.3	90.8	60.0	243	89.5
3	49.3	97.5	107,930	71.2	90.1	69.4	246	105.0
4	54.5	97.8	119,260	71.9	93.2	75.9	249	115.0
5	58.7	98.3	.....	....	....	78.4	261	102.5

Table III—Average Efficiencies

Series	Overall	Transmission
III-A	72.4	91.0
III-B	69.2	86.8
III-C	69.7	87.6
III-D	70.7	88.0
III-E	72.1	90.6
III-F	72.0	91.4

Average coefficient, all series, 258.

Table IV—Heat Transmission Summary for Cast-Iron Kettle

Series No.	Hydrostatic Head (Ft.)	Temperature Gradient 60 Deg. F.	70 Deg. F.	80 Deg. F.
		Coefficient *U*		
III-A	1.05	276	280	280
III-B	1.16	252	262	271
III-C	1.27	246	258	261
III-D	1.38	245	264	266
III-E	1.49	248	253	252
III-F	1.59	240	250	251

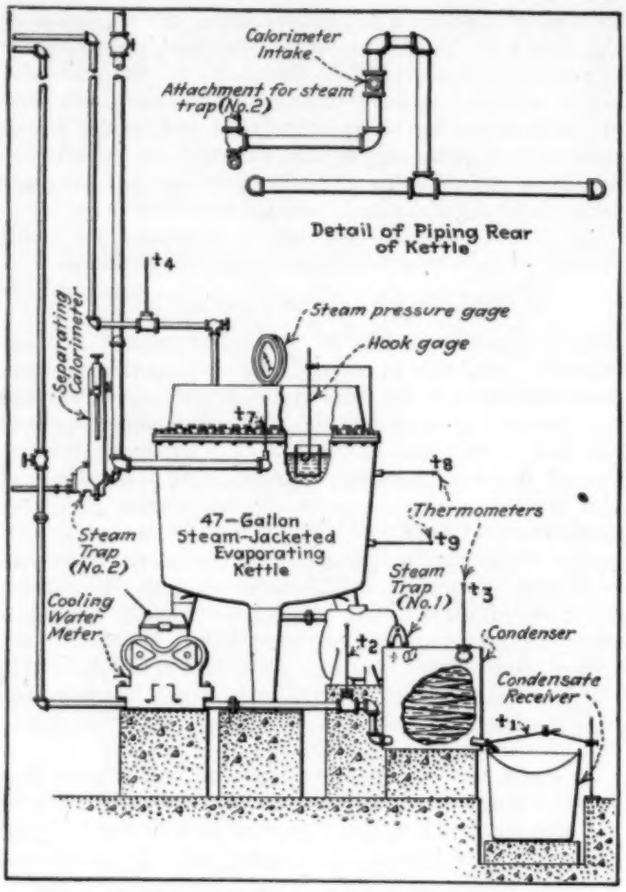


Fig. 2—Set-Up of Kettle for Test

face being measured by means of a delicate anemometer. Results obtained are shown in Table I.

The nature of this special case made necessary the calculation of heat radiated as the difference between that supplied and that removed through the condenser. In all other cases transmission was measured by the amount of water evaporated.

Effect of Temperature Gradient and of Hydrostatic Head

The apparatus with the insulating jacket as described above was used in six series of tests to determine what influence the height of water level and the temperature gradient exert on transmission. Fig. 1 shows the variation in level and of heating surface through the range of heads from 1.05 ft. to 1.59 ft. In each case the time of run was 30 minutes measured with a stop watch, and readings were taken at 3-minute intervals.

The values given in the tables are plotted in Fig. 3. It may be seen from these curves that the coefficient rises with increase in temperature gradient. This rise may be due in part to the fact that ebullition becomes more vigorous as the temperature rises and consequently the surface of evaporation and the area of the heating surface increase. Moreover—and this is perhaps still more significant—the film of liquid or vapor clinging to the inner surface is more effectively scoured off by the shearing action of the convection currents. A summary of the results given above is made in Table IV.

The kettle used in this series was one manufactured by the J. L. Mott Iron Works, described as 54-gal. enamel-lined 111-X. Except for minor details the set-up and methods of measurement were the same as followed

in the preceding work. The arrangement is shown in Fig. 2 and dimensions and wall thickness in Fig. 1. As might be expected, the rate of heat flow is low and high steam pressures were needed to keep the evaporating water at the boiling point.

Results are remarkably constant and they doubtless may be accepted as standard for apparatus of the kind. Recently Poste (*Ind. Eng. Chem.*, 1924, vol. 16, p. 463) in discussing enameled cast-iron kettles ranging in thickness from ½ to 1 in. gave values for the overall coefficient ranging from 52 to 60. It should be noted that our kettle is only ½ in. in thickness and also that Poste does not mention the thickness of enamel lining.

Film Coefficients. No direct measurements were made on film conductivities, desirable as they might be. It is interesting to note, however, that by substituting known or approximate values in the equation

$$\frac{1}{H}=\frac{1}{h_1}+\frac{L}{k_2}+\frac{1}{h_3}, \qquad (4)$$

the value of h_1 may be calculated. If H is 260, h_3, the film between steam and the metal, 2,200, as suggested by McAdams, and k_2, the conductivity of ½ in. of cast iron, is 864, then h_1, the conductivity of the film between the metal and boiling water, is 456. In the case of the enameled kettle no data for conductivity of the special glass are available and so that for flint glass (0.3) is used. On substituting in the formula as before, we get 249 for h_1. Naturally we should expect a lower figure than in the other case because of the considerably lower speed of the convection current.

In the use of any of the common metals such as iron, copper or aluminum for apparatus of this kind it is obviously difficult to maintain a chemically clean surface. Consequently the accuracy of water or steam film conductivity data is vitiated by indefiniteness of the cleanliness factor, for the oxide film must of course exert a marked influence on transmission. Indeed, in a later paper we shall show that in the case of a copper kettle a film of oxide serves as a material insulator, our results being directly comparable with those obtained by Pridgeon and Badger with tarnished evaporator tubes.

Location of Air Pockets

As a means of locating air pockets in the steam jacket thermometers inserted in brass stuffing boxes distributed as shown in Fig. 1 were provided, since variations in temperature indicate the presence of non-condensable gases. Readings were averaged and corrected and the results are tabulated in Table VI.

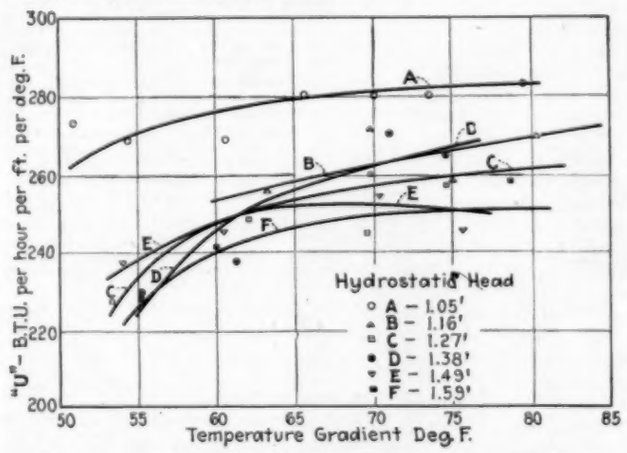


Fig. 3—Relation Between Coefficient and Temperature for Various Tests

Table V—Heat Transmission in Enameled Kettle

Series IV—IB
Head = 1.16 in.

Run No.	Abs. Steam Press. (Lb. per Sq.In.)	Water Evaporated, Lb.	Temp. Grad. Deg. F.	*U* Steam to Water
1	40.2	20.0	57.4	67
2	46.6	23.5	65.1	70
3	50.5	26.0	72.0	70
4	54.9	27.0	74.7	70
5	59.5	30.5	79.7	74
Mean	....	....	....	70

Table VI—Variation in Jacket Temperatures

(See Fig. 3)

Run No.	t_7	t_8	t_9	t_{10}	t_7-t_8	t_7-t_9	t_7-t_{10}
Series III-A							
1	262.0	261.1	261.5	260.1	0.9	0.5	1.9
1a	265.1	263.8	264.2	262.2	1.3	0.9	2.9
2	271.4	271.4	272.2	269.6	0.0	—0.8	1.8
2a	276.8	275.9	275.9	274.8	0.9	0.9	2.0
3	280.6	279.3	279.3	277.7	1.3	1.3	2.9
3a	281.1	.....	.....	.....	...	...	...
4	284.4	282.9	282.4	280.9	1.5	2.0	3.5
5	290.3	289.2	289.4	284.7	1.1	0.9	5.6
Series III-B							
1	266.2	262.9	266.0	263.5	3.2	0.2	2.7
2	273.2	272.5	273.2	261.4	0.7	0.0	1.8
3	280.2	279.0	279.1	278.1	1.2	1.1	2.1
3a	281.3	.....	.....	.....	...	...	...
4	286.9	284.9	284.7	284.2	2.0	2.2	2.7
5	290.7	289.4	289.6	289.0	1.3	1.1	1.7
5a	291.0	289.9	289.2	285.4	1.1	1.8	5.6
Series III-C							
1	263.7	262.6	263.1	261.3	0.9	0.6	2.4
2	271.9	271.8	272.3	270.7	0.1	—0.4	1.2
3	280.9	279.5	279.1	278.4	1.4	1.8	2.5
3a	280.6	.....	.....	.....	...	...	...
4	289.9	284.2	283.6	278.8	5.7	6.3	11.1
Series III-D							
1	266.5	264.6	264.4	265.1	1.9	2.1	1.4
2	273.0	272.5	271.8	271.0	0.5	1.2	2.0
3	281.8	280.0	279.1	278.8	1.8	2.7	3.0
3a	281.8	.....	.....	.....	...	...	...
4	285.8	283.8	282.7	282.7	2.0	3.1	3.1
Series III-E							
1	265.1	263.7	262.8	258.4	1.4	2.3	6.7
2	271.9	271.4	271.0	266.9	0.5	0.9	5.0
3	280.6	279.3	278.8	274.3	1.3	1.6	6.9
3a	282.0	.....	.....	.....	...	...	...
4	287.1	284.5	283.5	279.5	2.6	3.6	7.6
Series III-F							
1	265.5	263.8	263.5	262.4	1.7	2.0	3.1
2	271.2	270.5	270.1	269.6	0.7	1.1	1.6
3	280.6	279.3	279.0	278.2	1.3	1.6	2.4
4	287.1	285.3	284.5	284.0	1.8	2.6	3.1
5	289.6	288.9	288.3	288.1	0.7	1.3	1.5

It is evident that except for a few cases the temperature variation was not great and it is probable that no air pockets of great size or permanence were present. Under other conditions, however, it is conceivable that non-condensable gases might collect and it is of course advantageous to have available means for venting them.

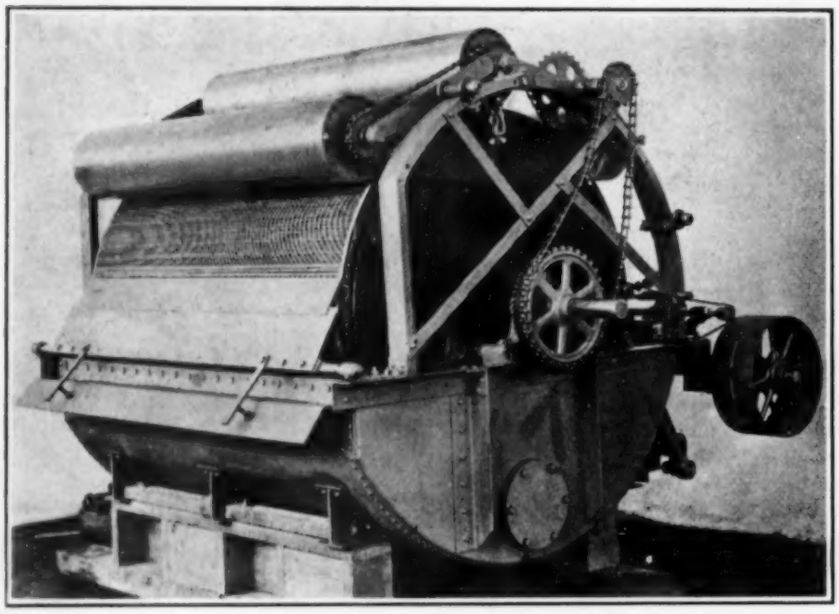
The following estimate of the final accuracy of results is reached after an examination of the possible magnitude of errors in reading thermometers and gages and making weighings: for overall efficiencies 0.5 per cent; transmission efficiencies 1.5 per cent, and for the transmission coefficient 2.5 per cent.

The values of the transmission coefficients from steam to boiling water in cast-iron and enameled cast-iron kettles of a widely used type have been determined as 260 and 70 respectively. The coefficient from steam to air which represents radiation loss is 5 when no air drafts interfere; with moderate circulation this may be increased 25 per cent.

Increase in temperature gradient causes a rise in the value of the transmission coefficient, although in the case of walls of high resistance the effect is very small. Increase in hydrostatic head decreases the coefficient and this effect is least marked when large gradients are employed.

Equipment News

From Maker and User



Filter for Thickening Paper Pulp

Thickening Pulp

One of the latest uses for the Oliver filter, made by the Oliver Continuous Filter Co., Oakland, Calif., is in thickening paper pulp. When the filter is equipped with press rolls as shown in the accompanying photograph, the cake can be discharged up to 30 per cent air dry. When pulp is being discharged at less than 15 per cent air dry, these press rolls are not employed.

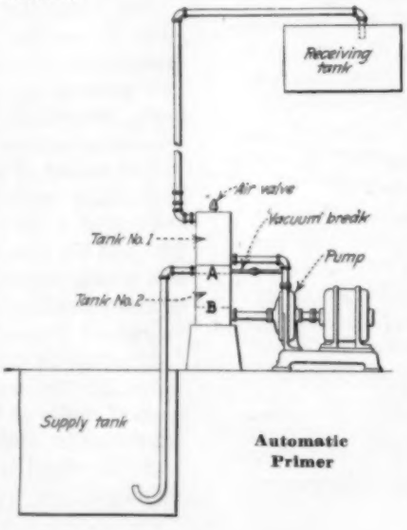
Pulp is fed to the filter at approximately 1 per cent concentration in water, in some cases being 0.75 per cent and in others 1.5 per cent. This stock flows in a continuous stream into the filter tank. The filter operates by the well-known Oliver method, picking up a sheet or cake of pulp and removing water from it by vacuum. After the drum has completed almost one revolution from the point where it entered the tank, the pulp is removed by the scraper—the vacuum being cut off on the section from which the pulp is being removed until that section again enters the tank.

When the press rolls are used and pulp is removed from the filter 30 per cent air dry, it comes off continuously in solid, uniform sheet which may be easily shredded for bleaching at "high density." When bleaching is to be done in Bellmers, only part of the pulp is thickened on the Oliver to from 10 to 15 per cent air dry. This is then mixed with the remaining thin stock, the resulting mixture going to the Bellmers at from 6 to 8 per cent air dry.

Several advantages are claimed for this method of thickening pulp, among which are uniform results, the discharge of pulp at unvarying density, the elimination of fiber losses and more economical operation through elimination of shut-downs.

Automatic Primer

When using a horizontal centrifugal pump against a suction lift there is often trouble in keeping the pump primed. A number of systems of overcoming this difficulty have been devised, in most cases involving the use of foot valves, which are not highly satisfactory; or using some mechanical device for maintaining a vacuum on the suction.



Automatic Primer

A system that does away with these devices and depends for its operation only on tanks and fittings has been devised by the Automatic Primer Co., 111 West Washington St., Chicago, Ill. It consists of two tanks, placed one above the other. The upper tank is connected to the pump delivery and to the receiving tank and is provided with an air relief valve. The lower tank is connected to the supply and to the pump suction. A vacuum break line is provided between the lower tank and the pump discharge pipe.

By referring to the accompanying diagram the operation can be seen. Tank No. 2 is filled with liquid to the level *A*. When the pump is started, it lowers the liquid to level *B* and in so doing produces a vacuum in tank No. 2. As the pump continues to remove liquid from tank No. 2, liquid is replaced by an equal quantity from the suction line. When pumping, tank No. 1 is filled with liquid. When the pump is stopped, the air valve on tank No. 1 opens and allows the liquid in the tank to return by gravity through the pump to tank No. 2, forcing the air back through the suction, thus flushing the suction line and repriming the system.

Manufacturers' Latest Publications

Frick Co., Waynesboro, Pa.—Series E4. The latest of the series of bulletins issued by this company entitled "Ice and Frost," describing Frick inclosed compressor and refrigerating equipment and its use in the food products industry.

Steere Engineering Co., Detroit, Mich.—Pamphlet 264. A leaflet describing sherardized cooling coils for use in condensers and coolers in gas plant work.

Copper & Brass Research Association, 25 Broadway, New York City—A pamphlet entitled "The Story of Yesterday and Today," describing the uses of brass, bronze and copper in industry and the arts.

Foamite-Childs Corporation, Utica, N. Y.—A new catalog entitled "Dipping Dangers," which describes the application of fire protection to industries using dip tanks, tempering vats, dry cleaning tubs, open oil storage tanks, varnish kettles and other similar equipment.

J. A. Martocello & Co., Philadelphia, Pa.—Catalog 50. A new catalog of raw water ice-making systems and supplies.

National Tank & Pipe Co., Portland, Ore. Catalog 24. A new and complete catalog of wood tanks, piping and allied equipment. This catalog contains specifications and directions for setting up standard tanks, and also descriptions of special equipment made for the storage of oil and for similar uses. Information on Douglas fir tanks for the paper-making industry is included, as are also a number of valuable tables of general information.

Universal Coal Spreader Co., 53 West Jackson Blvd., Chicago, Ill.—A catalog on the Universal coal spreader, giving a full description and specification of this device, which is used as an auxiliary to the mechanical stoker for the purpose of maintaining an even fuel bed.

Quigley Furnace Specialty Co., Inc., 26 Cortlandt St., New York City—A new catalog entitled "Hytempite in the Power Plant." This catalog describes and illustrates successful applications of this material in refractory construction and maintenance.

Readers' Views and Comments

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Chilean Nitrate Monopoly

To the Editor of Chem. & Met.:

Sir—My attention has been called to the article in your issue of May 19, under the heading "Chilean Nitrate Producers Tighten Grip on Monopoly."

I have been directly in touch with the nitrate business for the last 25 years, and a partner in one of the large American nitrate importing houses. During my long experience in nitrate I cannot recall any unfriendly attitude or act toward Americans on the part of the nitrate interests in Chile. Indeed, the contrary has been the case, and I might cite that in recent negotiations for renewal of the Nitrate Producers Association one of the Chilean nitrate producers declined to join the association unless the American producers were compelled to go in. This threat had no effect whatever upon the association, and was completely ignored by it. The association has understood the situation that confronts American producers and has at no time attempted to use pressure to bring them in. I cannot, therefore, see the justification for the statement you make: "It is a clear declaration of war against American interests in the nitrate business."

I do not think that we, as Americans, can with good grace criticize any action taken by the association which relates to Chilean companies engaging in the nitrate business and the pressure that may be put forth to bring them into the association. What would we Americans say to outside criticism if the situation were reversed and the nitrate fields were within our borders? However, the interests of the Chilean companies that hesitated before joining were so small that they were practically negligible.

The nitrate business in Chile is conducted along broad and comprehensive lines, and no attempt has been made at gouging. Indeed, during the war this industry set a fine example for many others. It made no effort to extract the last pound of flesh, as it could very well have done. Just prior to the opening of hostilities in 1914, when there was no association of producers, nitrate was selling at 7/0 to 7/6 per Spanish quintal, according to quality. Labor was cheap, fuel was cheap and sterling, an important element in cost, was normal. If my memory serves me correctly, the highest price at which nitrate was sold during the war in any quantity was 13s. 6d. per Spanish quintal, and we all know to what extent costs advanced throughout the world. Coal was selling in Chile at three or four times as much as during the first half of 1914. Labor had gone up by leaps and bounds. Germans had substantial nitrate interests at that time and did everything possible to interfere with shipments, but without success, thanks to the efforts of the Chilean Government. Should a comparison be made of the increase in the prices of nitrate and the increase in prices of other necessary articles during the war period, the nitrate industry of our sister republic to the south would stand out in bold relief. Then they enjoyed a practical monopoly, yet they did not use it as such! What other essential war industry located in a neutral country can match this record?

There has been much talk in the newspapers about Chile having a monopoly of nitrate, with the implication that prices are kept unduly high. As a matter of fact, the Chilean nitrate producers have not a monopoly, since nitrate from the air is now manufactured in several countries and besides, sulphate of ammonia, cottonseed meal and many other articles are competitive. The new prices for nitrate range from 19s. 3d. to 20s. 9d. per metric quintal, or roughly the equivalent of 8s. 10½d. to 9s. 6½d. per Spanish quintal. This shows an average increase of about 27 per cent over the prices ruling in July, 1914. With the materially higher cost of labor, fuel, etc., can it be said that this increase in price is unwarranted? Indeed, some producers have closed down because they cannot operate profitably at the new prices. On the other hand, it is true a few producers who have rich deposits on their property operate at comparatively low cost and make good profits, but they are a small minority. This condition is not unique with Chile, but is true of all similar industries, particularly metals. A mine with rich ores or rich caliche naturally shows larger profits.

Let us be fair to the nitrate industry, especially as it is an American industry on our southern continent. We should do all we can to foster the friendliest relations with our sister republic to the south. Much labor has been spent in the past to bring us closer together, and it would be a pity for these efforts to be put in jeopardy, which might be the case if unjust and unwarranted criticisms are aimed at her principal industry. It is surely not the way to build up an interchange of trade between us. Nitrate is to Chile what cotton is to our Southern states and wheat to our Northwest.

It has been difficult to understand why there has been so much discussion about the cost of fertilizers. Any one who will take the trouble to investigate the fertilizer industry here in the United States will find that prices during the past season, and indeed for some time prior, have been on the average below or at about the cost of manufacture. Indeed, I venture to say that there has been less financial remuneration in the manufacture of fertilizers than in almost any other trade, due to the low prices that have been accepted by the manufacturers. Naturally, we all wish to see the farmer treated with the utmost fairness, because unless he is prosperous our country cannot be prosperous. He certainly has bought his fertilizers at very low prices and his major relief must be in the prices he secures for his crops. He has paid comparatively much more for other necessary articles such as clothing, food, etc., than he has for fertilizers that are used by him to increase his crops and therefore to enlarge his profits.

Feeling sure that it is your intention to be fair to all and to hear impartially both sides of a question, I trust you will give this communication the same publicity you gave to the article referred to herein.

New York City. P. W. ALEXANDER.

Book Reviews

Oil Field Technology

TEXTBOOK OF PETROLEUM PRODUCTION ENGINEERING. By *Lester C. Uren*, associate professor of petroleum engineering, University of California. 657 pages, 348 illustrations. McGraw-Hill Book Co., New York. Price, $6.

In the preface the author states: "The writer's principal purpose in preparing this book has been to provide a text or work of primary reference for petroleum engineering students in that part of their curriculum which pertains to the technology of oil field development and petroleum production." The writer has accomplished very satisfactorily the object intended—that is, the preparation of a text book for the use of petroleum engineering students. It will be useful, however, to many engineers and geologists that have not had experience in all phases of oil field development and engineering.

The book contains 657 pages, with many good illustrations, tables, etc. It is well written, well arranged and has apparently been carefully edited. At the end of each chapter the author has given a rather complete bibliography on each of the subjects discussed. Quotations from other publications are used freely and the quotations selected have been well chosen.

In a book of this size, obviously it is possible to criticize certain parts of the text; for example, Fig. 6 on page 20. It would be most exceptional for one well to penetrate the same oil sand three times, and such figures as this might give the student a wrong impression regarding the usual occurrence of oil and gas. I have never seen commercial production coming from the same oil sand encountered three times in one well. Figures such as this one, however, are rare and in general the figures are well selected and illustrate the points to good advantage.

In a revision of the book the author will undoubtedly make certain improvements. For example, in the discussion of the oil and gas rights on Indian reservations, he has discussed the royalties and method of handling land by the Osage Indian Agency. The Commissioner of Indian Affairs handles oil and gas lands for many tribes other than the Osages and these might be enlarged upon to advantage. This, of course, is of particular interest in Oklahoma.

The principal criticism of the book is that it savors a little too much of the California practices. In a revision, additions can probably be made to give equal weight to the practices in the mid-continent and eastern fields. I feel, however, that it is the best text book for petroleum engineering students that has come to my attention and the author has done an extremely valuable and most commendable piece of work in its compilation and preparation.

A. W. AMBROSE.

U. S. Patents Issued July 1 and 8, 1924

Twin-Tunnel Kiln and Method of Operating the Same. Conrad Dressler, Cleveland, O., assignor to American Dressler Tunnel Kilns, Inc., Cleveland.—1,499,354.

Process for Extracting Certain Valuable Constituents as Byproducts From the Cooking Liquors Derived From the Production of Wood Pulp to Be Converted Into Paper. Edward G. Goodell, Stevens Point, Wis.—1,499,363.

Retort or Still. Frederick Lamplough, Feltham, England, and Neville C. Thomason Harper, Durban, Natal, South Africa.—1,499,378.

Electrolyte for Electrolytic Cells. Joseph Slepian, Swissvale, Pa., assignor to Westinghouse Electric & Manufacturing Co.—1,400,414.

Apparatus for the Treatment of Fluids. Edward Shaw, Toronto, Ont., Canada.—1,499,481.

Welding Machine. Edgar A. Bienenstok, Milwaukee, Wis., assignor to Milwaukee Tank Works, Milwaukee, Wis.—1,499,498-9.

Air and Other Separator. George H. Fraser, Brooklyn, N. Y.—1,499,515.

Pulverizing Mill. George H. Fraser, Brooklyn, N. Y.—1,499,516.

Separator. George H. Fraser, Brooklyn, N. Y.—1,499,517.

Machine for the Manufacture of Glass Articles. Robert F. Hall, Moseley, near Birmingham, England.—1,499,523-6.

Method of Making Nitrous Oxide. Max P. Miller and Maurice F. Roche, Cleveland, O., assignors to Lennox Chemical Co., Cleveland.—1,499,544.

Machine for Grinding Wood Into Pulp. Paul Priem, Heidenheim-on-Brenz, Germany, assignor to American Voith Contact Co., New York, N. Y.—1,499,547.

Making Colloidal Suspensions. Carolyn S. Smith, Brooklyn, N. Y.—1,499,600.

Phosphoric Acid in Dehydrated Form and Method of Making the Same. James H. Gravell, Elkins Park, Pa.—1,499,611.

Grinding Machine. Kristian Middelboe, Fredericksberg, Copenhagen, Denmark, assignor to F. L. Smidth & Co., New York, N. Y.—1,499,624.

Method of and Apparatus for Treating Nitrogenous Waste Materials. Frank N. Moerk, Philadelphia, Pa., assignor of one-half to Clarence P. Landreth, Philadelphia, Pa.—1,499,626.

Gas and Oil Separator. Edwin C. Weisgerber, Long Beach, Calif.—1,499,710.

Separator. George H. Fraser, Brooklyn, N. Y.—1,499,720-5.

Process of Producing Gas. James H. Reid, Readsboro, Vt., assignor to International Nitrogen Co., Cleveland, O.—1,499,750.

Production of *m*-Amino-Benzaldehyde. Don W. Bissell, Buffalo, N. Y. assignor to National Aniline & Chemical Co., Inc., New York, N. Y.—1,499,761.

Kneading Machine. Albert Sharp and George Sharp, Bayonne, N. J.—1,499,790.

Preservative Treatment for Timbers. Grant B. Shipley, Pittsburgh, Pa.—1,499,791.

Material-Elevating Apparatus. Barton S. Snow, Batavia, Ill., assignor to T. W. Snow Construction Co., Chicago, Ill.—1,499,792.

Process for Preparing Exchange Silicates for Industrial Purposes. James B. Wherry, Ardmore, S. D.—1,499,795.

Process for Oxidizing Organic Substances in Alkaline Liquors. Jean D'Ans, Berlin, Germany.—1,499,798.

Mixing Machine. William N. Stevens, New York, N. Y., assignor to Stevens-Aylsworth Co., New York.—1,499,890.

Separator. Thomas J. Sturtevant, Wellesley, and Edward A. Sawyer, Swampscott, Mass., assignors to Sturtevant Mill Co., Boston, Mass.—1,499,892.

Method of and Apparatus for Absorbing Gases in Liquids. Robert B. Wolf, New York, N. Y.—1,499,898.

Process of Activating Carbon. Newcomb K. Chaney, Kew Gardens, N. Y., assignor to National Carbon Co., Inc.—1,499,908.

Electric-Arc Furnace. William S. Hadaway, Jr., New Rochelle, N. Y.—1,499,922.

Indigoid Vat Dyestuff and Process of Making Same. Karl Thiess, Lindlingen, near Hochst-on-the-Main, and Carl J. Muller, Hochst-on-the-Main, Germany, assignors to Farbwerke vorm. Meister Lucius & Bruning, Hochst-on-the-Main, Germany.—1,500,013.

These patents have been selected from the latest available issue of the "Official Gazette" of the United States Patent office because they appear to have pertinent interest for "Chem. & Met." readers. They will be studied later by "Chem. & Met.'s" staff, and those which, in our judgment, are most worthy will be published in abstract.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Process of Distilling Oil. John J. Allinson, Bertlesville, Okla., assignor, by mesne assignments, to Doherty Research Co., New York, N. Y.—1,500,040-1.

Continuous Chlorination of Ligno- and Pecto-Cellulose by Nascent Chlorine for the Purpose of Obtaining Pure Cellulose. Antoine Regnouf de Vains, Miribel, Ain, France.—1,500,060.

Art of Impregnating Wood. Hans Finkelstein, Uerdingen-on-the-Rhine, Germany.—1,500,066.

Process and Device for Preparing Alcohols and Aldehydes From Hydrocarbons. Carolus A. Kloppenburg, Tjepoe, Dutch East Indies, assignor to Naamlooze Vennootschao de Bataafsche Petroleum Maatschappij, The Hague, Netherlands.—1,500,080.

Continuous Brine Purifier. Herbert D. Oxley, Chicago, Ill.—1,500,096.

Diaphragm Pumping Device. William C. Carter, St. Louis, Mo.—1,500,105.

Filter-Press Cloth. Harry C. Hale, Baltimore, Md., assignor to William E. Hooper & Sons Co.—1,500,124.

Process of Purifying Brine for Electrolysis. Hugo H. Hanson, and John T. Leecock, Bangor, and Charles A. Blodgett, Brewer, Me.—1,500,126.

Dry Filter. Burt S. Harrison, Chicago, Ill., assignor to Drying Systems, Inc., Chicago, Ill.—1,500,128.

Process of Purifying Mineral Oil. Earl Petty, Winfield, Kan., assignor to De Laval Separator Co., New York, N. Y.—1,500,202.

Process of and Apparatus for Making Fiber Boards. John K. Shaw, Minneapolis, Minn., assignor to C. F. Dahlberg, St. Paul, Minn.—1,500,208.

Felting and Recessing Machine. John K. Shaw, Minneapolis, Minn.—1,500,209.

Weighing Moving Material. Martin Castricum, Springfield, Mass., assignor to Fisk Rubber Co., Chicopee Falls, Mass.—1,500,233.

Furnace-Roof Construction. Raymond E. Griffith, Philadelphia, Pa.—1,500,240.

Method of Treating Coal. Theodore Nagel, Brooklyn, N. Y.—1,500,256.

Compounding Vehicle or Base. Joseph Schneible, Chicago, Ill.—1,500,276.

Method of and Means for Separating Oil from the Refrigerant in Refrigerating Systems. Thomas Shipley, York, Pa.—1,500,279-80.

Process for the Production of an Alkali Metal Sulphate and Hydrochloric Acid. Josef Weber, Essen, Germany.—1,500,289.

Process of Making Resinous Material from Paraldehyde. Carleton Ellis, Montclair, N. J.—1,500,303.

Oil-Shale Extraction Process. Robert W. Jenkins, Richmond, Calif.—1,500,323.

Fuel Feed for Furnaces. Claud M. Tackabery, Portland, Ore., assignor of one-half to Joseph W. Baker, Portland, Ore.—1,500,348.

Cellulose-Ether Composition. Stewart J. Carroll, Rochester, N. Y., assignor to Eastman Kodak Co., Rochester, N. Y.—1,500,366.

Process of Bleaching Fibrous Material. Viggo Drewsen, Brooklyn, N. Y., assignor to West Virginia Pulp & Paper Co., New York, N. Y.—1,500,378.

Method of and Apparatus for Drawing Sheet Glass. Robert L. Frink and Fred J. Frink, Lancaster, O.—1,500,381.

Method of and Apparatus for Mixing Materials. Erle P. Halliburton, Duncan, Okla.—1,500,385.

Shaking Screen, Frank C. Morrow, Wellston, O.—1,500,415.

Paper Making. Frederick Kaye, Ashton-on-Mersey, England.—1,500,500.

Drying Apparatus. Frederic P. Reed, East Orange, N. J., assignor by direct and mesne assignments, to Waterford Art Papers, Inc., Waterford, N. Y.—1,500,592.

Gaseous Fuel and Process of Producing Same. James R. Rose, Edgeworth, Pa., assignor to Carbo-Oxygen Co., Pittsburgh, Pa.—1,500,594.

Art of Dealcoholizing Liquids. Herman Heuser, Evanston, Ill.—1,500,618.

Glass-Making Apparatus. William R. Smith, Buffalo, N. Y.—1,500,651.

Calender. Thomas Midgley, Hampden, Mass., assignor to Fisk Rubber Co., Chicopee Falls, Mass.—1,500,679.

Method of Vulcanizing. Ernest Blaker, Akron, O., assignor to B. F. Goodrich Co., New York, N. Y.—1,500,700.

Control System for Air Lifts. William H. Elbelt and Charles H. Brooks, Hurley, N. M.—1,500,703.

Apparatus for the Treatment of Solid Substances in a Gaseous Atmosphere. Aladar Perczel, Ujpest, Hungary.—1,500,715.

Process of Recovering Lactose or Milk Sugar From Milk or Whey. Roger W. Ryan, Oconomowoc, Wis., Assignor to Carnation Milk Products Co., Seattle, Wash.—1,500,770.

Electrometallurgical Process for Manufacture of Ductile Bodies of High Fusing Metals and Alloys of Same. Eiji Aoyagi, Kyoto, Japan.—1,500,789.

Catalysts. Maurice E. Bouvier and Emile Blanc, Lyon, France, assignors to Société Chimique des Usines du Rhone, Paris, France.—1,500,794.

Oil-Soluble Dyestuff. Hermann Plauson, Hamburg, Germany.—1,500,844.

Process and Apparatus for the Manufacture of Dispersoids. Hermann Plauson, Hamburg, Germany.—1,500,845.

Drier. Swan G. Bonaparte, St. Paul, Minn.—1,500,862.

Vulcanizer. Gust A. Nelson, Sedro Woolley, Wash.—1,500,885.

Composition for Removing Paint and Varnish. Arthur W. Scoles, Tulsa, Okla.—1,500,899.

Dyes and Process of Making Same. Robert Arnot, Bushey, England.—1,500,915.

Drying Apparatus. Joseph L. Buckley, Trenton, N. J., assigner by mesne assignments, to Proctor & Schwartz, Inc., Philadelphia, Pa.—1,500,923.

Manufacture of Lead Alloys. Walther Mathesius and Hans Mathesius, Charlottenburg, Germany.—1,500,954.

Apparatus for Extracting Oil, Fats and Waxes, and for Conditioning Maize and Other Grain. Joseph Nield, Salisbury, South Rhodesia, S. A.—1,500,957.

Manufacture and Production of Caustic Soda. Richard O. Jones, Cricklewood, London, England, assignor to Courtaulds, Ltd., London, England.—1,500,993.

Effecting the Separation of Sodium Carbonate From Liquors or Solutions Containing Caustic Soda. Richard O. Jones, Cricklewood, London, England, assignor to Courtaulds, Ltd., London, England—1,500,994.

Manufacture of Caustic Soda. Richard O. Jones, London, England, assignor to Courtaulds, Ltd., London, England.—1,500,995.

Distillation with Aluminum Chloride. Almer McD. McAfee, Port Arthur, Tex., assignor to Gulf Refining Co., Pittsburgh, Pa.—1,501,014.

News of the Industry

Summary of the Week

Graduate chemical students may be appointed assistant attaches at foreign centers to replace the chemical trade commissioner.

Chemical Warfare Service Reserves called out for special summer duty.

Riordon Co., Ltd., has announced sale of all assets, in small parcels, at open auction.

The Tariff Commission, on August 1, will begin field investigations to gather necessary figures on cottonseed oil.

New building of Institute of Paint and Varnish Research is ready for occupancy at Washington, D. C.

Consensus of opinion among chemists indicates that Muscle Shoals may become a chemical center.

Muscle Shoals May Become a Chemical Center

Disinterested chemists are coming more and more to the belief that Muscle Shoals is destined to become a center for general chemical manufacture rather than for the production of fertilizer. The work on the Wilson dam is much ahead of schedule. All indications point to the fact that it will be completed and that power will be ready for delivery before the close of this fiscal year. For that reason, more and more thought is being turned to the chemical applications to which this new source of power will be put.

The difficulties which have overtaken the cyanamid process even in Norway, has led to the conclusion that these difficulties are fundamental and that it is apparent that this process would have little practical promise at Muscle Shoals. It is agreed quite as generally that Muscle Shoals is not the place for the application of the Haber process.

The proposal to make urea at Muscle Shoals likewise excites no enthusiasm from disinterested chemists. They point out that urea never has been developed at a price which would permit its use as fertilizer and there is very general doubt that this could be accomplished at Muscle Shoals.

On the other hand no reason is seen why the cyanamid and the carbide plants may not be kept intact. The opportunities are favorable, it is believed, to the manufacture of sodium cyanide and various cyanogen compounds. The prussiates particularly could be made to advantage, it is thought. Synthetic acetic acid and various acetylene derivatives constitute another group, the manufacture of which could be undertaken at Muscle Shoals. In fact the opinion prevails that a long list of chemical salts and compounds could be manufactured to advantage at Muscle Shoals, and it is expected fully that it will become in time a great center of the manufacturing chemical industry.

Germans Resent Publication of Dye Plant Outputs

Publication by this Government of figures showing the output of individual German dye plants has raised a storm of protest in Germany. It is claimed that this constitutes a violation of the agreement with the Reparations Commission. In this connection, it is pointed out that all governments in publishing figures as to their own industries are careful to safeguard the statistics in such a way that the production at individual plants is not revealed.

Assistant Attaches May Replace Trade Commissioner Abroad

In view of the difficulties incident to the securing of the services of one properly qualified to serve as a special chemical trade commissioner abroad at the salary which can be offered, an alternative is under consideration which would provide assistant attaches at certain of the centers of information regarding chemical activities. It is believed that graduate chemical students could be induced to take these positions more with the idea of adding to their education than from any inducement of other remuneration. The commodity idea has worked so well in the Bureau of Foreign and Domestic Commerce that there is sentiment in favor of extending it to the offices of the Department abroad. Insofar as the chemical industry is concerned, it is believed that several alert young chemists could gather a large amount of information which would be of value to the American industry. The only question is whether this type of service which would be of a fact-finding variety, leaving it to the industry here to interpret, would be as useful as the general conclusions and advice of a single commissioner who would have the background of experience and more mature judgment.

Canadian Department of Mines Announces Research Program

The Mines Branch Department of Mines, Canada, has just issued its programme for the year 1924. Field investigations will be made regarding the following: The bituminous sands of Alberta, from which already pavements have been made for some of the western cities; the saline deposits of western Canada; the utilization of titaniferous iron ores in the vicinity of Lake St. John, Quebec, which ores may be rendered possible of development by the extensive hydro-electric power development now being carried out at the discharge of this lake; the industrial processes and uses for natural abrasive minerals; exploration for petroleum in Alberta and an extensive survey of Ontario gases will be carried on.

A study will be made with reference to trade requirements in respect to minerals for pulp and paper, paint, glass, chemical, rubber, textile, dyeing, electrical, oil and lubricating, and abrasive industries.

In the ore dressing and metallurgical division, researches will be carried out respecting the selective flotation of Canadian ores; the metallurgical treatment of Canadian gold ores; the preparation of Canadian non-metallic minerals; the leaching of Canadian pyrrhotite ores, and the roasting leaching of Canadian pyrite ores, with the subsequent electric deposition of iron from the leached solutions; the beneficiation of Canadian iron ores.

In the division of fuels and fuel testing, researches will be made regarding: an analysis survey of western coals; domestic heaters; domestic coke; carbonization of different classes of fuels; gasoline, lubricating oils, motor spirits by the Ramage process; oil shale. The ceramic and road materials division will take up the question of the general troubles related to the drying and burning of brick; and the road material resources.

News in Brief

Pulpwood Commission Report Nearly Ready—In the Canadian House of Commons on July 9, the acting minister of finance, Hon. J. A. Robb, said he had the assurance that the report of the Pulpwood Commission was almost completed. Replying to a statement that the commission had visited New York and Washington, Mr. Robb said that only some members of the commission had gone and that when the matter was brought to his attention, he wired them and they returned to Canada.

Hudson Valley Paper Industry Looks Up—The International Paper Co., New York, has reopened two of its largest mills, known as the Otis and Hudson River Mills, New York, at which operations recently were curtailed. It is expected to keep the plants in service for an indefinite period, with employment of close to normal working forces.

Trumbull-Cliffs Co. Completes Coke Plant—The Trumbull-Cliffs Co. has completed the construction of its new coke plant near Warren, O., following a number of months of intensive building. The plant represents an investment of close to $3,000,000, and will furnish coke for the blast furnace of the company in this district, which has a rating of 600 tons. A portion of the gas and other byproducts will be used at the Trumbull steel mills. The Trumbull-Cliffs furnace, used for hot metal production for the open-hearth department, has been overhauled and relined, and will be placed in service with the new byproducts coke works.

Canadian Asbestos Sales High—In its report covering the asbestos industry in 1923, the Dominion Bureau of Statistics states that from the point of volume of sales, last year may be considered the premier year for the asbestos industry in Canada, but the total sales value of this commodity declined very materially. The sales for the year totaled 231,482 tons, with a return to the operators of $7,522,506, compared with 163,706 tons sold in 1922, worth $5,552,723. The total quantity of asbestos rock mined during the year amounted to 3,768,542 tons, of which 3,217,580 tons was milled. The mill recovery of marketable asbestos was 237,000 tons. All asbestos produced in Canada is mined in Quebec.

Newsprint Production Higher in Canada—Canadian newsprint mills made a new high record in production during May, according to statistics supplied by the Canadian Pulp and Paper Association. The total for the month was 117,833 tons against 134,219 by United States mills and 111,486 tons by Canadian mills in May, 1923. For the first five months of 1924, Canadian mills produced 567,482 tons compared with 629,615 tons by United States mills, and 511,395 by Canadian mills during the same period last year.

Fisk Reopens Chicopee Plant—The Fisk Rubber Co., Chicopee, Mass., has resumed operations at its local mill, following a short curtailment. Production will be on a 5-day week basis instead of a 3-day week, as operative prior to the shutdown. The plant is devoted to automobile tire manufacture and will give employment to close to 2,400 persons.

Seeking Oil North of Montana—A party of geologists under Dr. M. Y. Williams of Vancouver, is being sent into southern Alberta this summer in connection with the active hunt for oil. Dr. Williams is confident that oil will eventually be found in commercial quantities in the area north of the Alberta-Montana boundary. He regards the Rogers-Imperial gas well as very important. His theory is that there are a number of folds radiating from the Sweet Grass Hills uplift, the Rogers well being one of these.

Vacuum Glass Bottle Firms Merge—Merger plans are said to be in progress by the American Thermos Bottle Co., New York, and the Icy Hot Bottle Co., Cincinnati, O., to include a grouping of plant facilities under one management. The combined assets of the two companies are estimated at $4,000,000. The first noted company operates plants at Norwich, Conn.; Huntington, W. Va.; Toronto, Ont.; London, Eng.; and Kokura, Japan, all of which will be maintained in service under the consolidation plans.

New Yellow-Green Dye To Be Marketed—Du Pont Alizarine Emerald, an acid dyeing alizarine dyestuff which produces on wool and silk, yellowish green shades of very good fastness to light, has just been placed on the market by the dyestuffs department of E. I. du Pont de Nemours & Co. In addition to its fastness to light properties, the color also is said to possess very good fastness to steaming, carbonizing, perspiration and acids, and also to resist washing fairly well. It is further claimed that it is easily soluble, is level dyeing and penetrates well.

Australia Developing Deposits of Arsenic

In a report from Newcastle, Consul Romeyn Wormuth states that the state arsenic mine at Jibbenbar, Australia, owing to a breakdown in machinery, was not as productive as expected. Stocks on hand at the beginning of 1923 amounted to 200 tons, and production during the year only reached 300 tons. The entire quantity was disposed of. Another rich-bearing lode has been found, and with the new machinery installed prospects for 1924 are good. Of the arsenic sold during the year, 65 tons were disposed of to farmers for prickly pear destruction.

A mine at Sundown produced 70 tons of arsenic and 700 tons of 30 per cent arsenic ore, of a total value of £10,220. Another plant at Sundown produced 200 tons of arsenic, valued at £8,390—an increase of 170 tons compared with the 1922 output. During the year works were established at Fassifern, New South Wales, for the production of white arsenic. Chemical works were also erected at Wallangarra for the purpose of treating ore from one of the Sundown mines. Two furnaces are in commission, treating 10 tons of ore daily and producing white arsenic averaging 99.8 per cent.

Trade Notes

The Tariff Commission's final report on the dye census is on the press. It probably will be available for distribution August 15.

J. F. Norman has been elected president of the Bigelow-Hartford Carpet Co., to fill the vacancy caused by the recent death of R. P. Perkins.

The Texas Chemical Co. of Houston, Texas, will build a fertilizer plant to cost $200,000. The company also has bought 150 acres at Baton Rouge, La., as a site for an acid plant.

The Hermetite Chemical Corporation of New York has leased the plant at Nutley, N. J., formerly owned by the American Nitration Co.

O. C. Harn, advertising manager of the National Lead Co., spoke on July 15 at the International Advertising Convention in London.

John M. Lowe, assistant secretary and treasurer of the Bisbee Linseed Co. at Philadelphia, will leave today for a business trip to Minneapolis and other western points.

A petition in bankruptcy has been filed against the Kendall Products Corporation, manufacturers of soap at 709 Sixth Ave., New York. Liabilities are placed at about $350,000 and assets at $150,000.

Hugh Hill, head of Edward Hill's Son & Co., and widely known in the alkali trade, died at his home in Irvington, N. Y. on July 7.

Foreign Silica Gel Co. Formed

Announcement of the formation of the Silica Gel Foreign Petroleum Corp. was made at New York last week. Officers of the Davison Chemical Co. and the Royal Dutch organization will be among the directors of the new company. The foreign Silica Gel company will take over the refining of petroleum products in all parts of the world outside of the United States.

The directors of the new company include J. B. August, Kessler William, Carroll de Louw and Fred Godber, representing the Royal Dutch interests, and C. Wilbur Miller, Waldo Newcomer, Robert Garret, Omar Hershey and Ernest C. Miller, representing the Silica Gel and Davison Chemical interests.

Commercial Solvents Corp. Place Large Contracts

In the report of the Commercial Solvents Corp. for the first 6 months of the year it was stated that new uses for the products of the corporation are being found which should result in increased demand. It was also announced that contracts had been made for the sale of solvents to the Eastman Kodak Co., E. I. du Pont de Nemours Co., Egyptian Lacquer Manufacturing Co., Maas & Waldstein Co., and Richards & Co. These contracts apply to deliveries over a period of years and cover full consuming requirements of the contracting parties.

Washington News

Schedules Mailed to Domestic Vegetable Oil Producers

Schedules for the use of domestic producers of cottonseed oil and peanut oil are being mailed by the Tariff Commission in connection with its investigation into costs of production of these oils and of soya bean oil and coconut oil under the terms of the flexible tariff. Field work in the United States will not begin until sufficient time has elapsed for these schedules to be started by the producers. The crew of commission experts sent to Europe has landed and the crew sent to the Far East has sailed.

The schedules for use in the domestic field were prepared after agents of the commission had conferred with producers in New York and in several centers of the South.

It is probable that the commission will not order any further major investigations for several months, having followed the vegetable oil order with one calling for an investigation into butter and dairy products. These two inquiries, together with the conclusion of work on investigations previously ordered, will absorb practically all of the funds that the commission has available for work under the flexible tariff in its appropriation for the 1925 fiscal year. An effort will be made to have Congress vote additional funds for the Tariff Commission at its December session.

Seven chemical cases are before the commission for report to the President, together with more than a score of other cases. It is not likely that any of these reports will be sent the chief executive before September, as the commission has been occupied for some weeks with its report on sugar and several of the commissioners will be away during most of August.

German Views on Grasselli-Bayer Working Agreement

Newspapers and correspondence reaching this country from Germany indicate that it is taken for granted in that country that a satisfactory agreement has been consummated between the Bayer Company and the Grasselli Dyestuffs Corporation. While there has been no formal confirmation of the reported agreement, the impression in Germany seems to be that this negotiation has been along the line of the proposal made to the British Dyestuffs Corporation by the I. G. Another of these 50-50 agreements, which would allow the purchase of the Bayer interests by the Grasselli corporation, seems to be regarded as a sensible adjustment of the situation and one which the Germans regard as likely to be satisfactory to the American corporation since it eliminates an important competition. It is known that the I. G. was firmly determined to carry through its plan of entering America and unless some such arrangement had been made, it seems very likely the alleged sale would not have been made.

According to one Berlin newspaper, the Grasselli corporation found it advisable to enter into the agreement because of the uncertainty involved in using otherwise the Bayer patented rights and processes. The use of the trade name "Bayer" also is involved, the paper states.

Chemical Warfare Reserve Called To Active Duty

A class from the reserve officers of the Chemical Warfare Service has been called to active duty for a special course of study. The class assembled July 7 and did intensive work until July 19. The class is comprised as follows: First Corps Area—Capt. Henry E. Soule, Dorchester, Mass.; Capt. Joseph Chandler, Medford Hillside; First Lieut. W. C. Mendum, Northfield, Vt.; 1st Lt. W. M. Scott, South Manchester, Conn.; 1st Lt. F. H. Springer, Providence, R. I.; 2nd Lt. Richard A. Wilkins, Belmont, Mass.

Second Corps Area—Lt. Col. Horace G. Byers, Montclair, N. J.; Major F. H. Phipps, New York City; Capt. Louis Harris, Newark, N. J.; 2nd Lt. V. T. Anukewicz, Brooklyn; 2nd Lt. L. W. Green, New Brunswick, N. J.; 2nd Lt. S. L. Van Orden, Oswego; 2nd Lt. Elton Tucker, New York City; 2nd Lt. L. C. Wellington, Massena.

Third Corps Area—Major James W. Purman, Washington; Capt. L. L. Beebe, Chevy Chase; Capt. L. L. Davis, Waynesboro, Va.; Capt. H. F. Hitner, Pittsburgh; Capt. O. I. Levy, Washington; Capt. J. C. Sawders, Pittsburgh; 1st Lt. Leonard Zoole, Philadelphia; 1st Lt. Edwin Smiley, Philadelphia; 2nd Lt. Robert E. Sadtler, Selinsgrove, Pa.; 2nd Lt. H. G. Beamer, Manor, Pa.; 2nd Lt. E. C. Goedel, Washington; 2nd Lt. H. E. Brooks, Washington; 2nd Lt. A. M. Ergood, Washington; 2nd Lt. J. J. Fahey, Washington.

Fourth Corps Area—Lt. Col. A. J. Bethea, Columbia, S. C.; Capt. W. H. Beisler, Gainesville, Fla.; Capt. E. A. Vaughan, Orlando, Fla.; Capt. J. W. Battle, Montgomery, Ala.; 1st Lt. E. B. Scruggs, Livingston, Ala.; 2nd Lt. K. E. Jackson, Athens, Ala.; 2nd Lt. J. K. Kimsey, Cornelia, Ga.

Sixth Corps Area—Capt. E. A. Schaaf, Chicago and 1st Lt. J. B. Baker, Urbana, Ill.

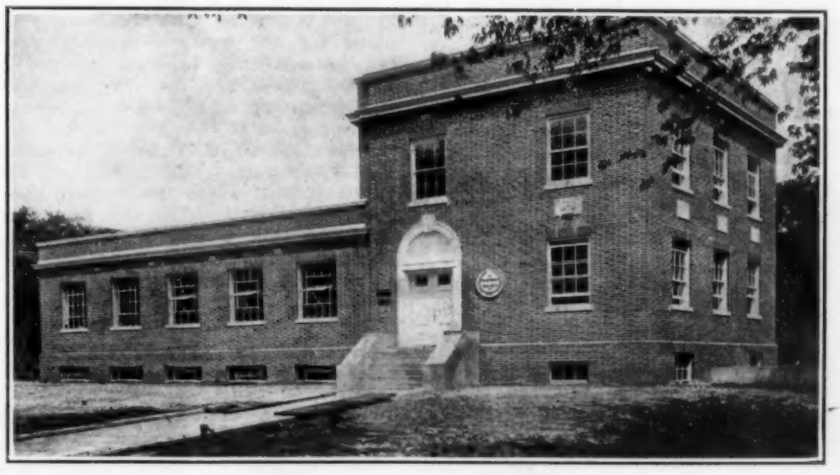
Seventh Corps Area—2nd Lt. R. Manning, Little Rock, Ark.

Ninth Corps Area—Major Frank B. Ebbert, San Francisco.

Large Potential Field for Use of Calcium Arsenate

Increased imports and decline in price should not discourage production of calcium arsenate, in the opinion of officials at Washington. They believe that few products have such a potential field. At the present time calcium arsenate is being used on less than 10 per cent of the cotton acreage to which it could be applied with advantage, even at present prices. It is admitted that the educational process which must precede any such innovation is a slow one, but the profit which comes to the cotton grower who uses calcium arsenate is sufficiently great to insure the retention of its use when once tried and its gradual expansion until it is used generally throughout the cotton belt.

No chemical commodity, the Government's chemists are convinced, has a more certain future than this great insecticide. The very fact that the Japanese and the Canadians have gone in for arsenic production on a large scale is regarded as a testimonial to their business vision.



New Home of Institute of Paint and Varnish Research

The Institute of Paint and Varnish Research has just announced the completion of the new quarters shown above. The new building is located in Washington, D. C. at the northwest corner of 22nd and New York Avenues and takes the place of the laboratory that has housed the laboratory for the past 14 years recently acquired by the government.

Research work is to be continued on paints, colors, oils, varnishes, etc., for the scientific section of the Paint Manufacturers' Ass'n of the United States, with the co-operation of the National Varnish Manufacturers' Ass'n.

Technical Sessions Feature A. I. C. E. Convention

Proposal to Hold Joint Meeting in London with British Institute of Chemical Engineers

Colorado's welcome to the American Institute of Chemical Engineers who met in Denver, July 15-18, was most sincere as well as enthusiastic. The convention, the second ever held west of the Mississippi, focused attention on the problems of an industry that lies close to the hearts and pocketbooks of Coloradians. Beet sugar production carries with it none of the thrill and romance of gold or silver but it has long since demonstrated its prowess as a breadwinner. Like the tortoise its march has been slow yet in the long run it has far outstripped the flashy progress of its fleeter rival. One of the reasons beet sugar is now Colorado's most important industry is traceable to the steady advance in the application of chemical engineering methods and processes.

Quite appropriately two of the three technical sessions were given over to the problems of beet sugar production. In addition to the valuable papers of Dahlberg, Maudru, Shafor and Zitkowski, all of which are published in this issue, Professor Edward Bartow outlined methods for disposing of the wastes of the industry and W. H. Baird discussed the important problem of sugar content in the beet. Thursday's session was marked by several outstanding papers on western industry. Two were from the Dorr Co., having to do with its methods and equipment in chemical industry and in the disposal of industrial wastes.

E. Anderson of the Western Precipitation Co. of Los Angeles, A. R. Chandler, Universal Oil Products Co., Chicago, and Wm. M. Barr, chief chemist of the Union Pacific Railroad, Omaha, were among those who presented papers which will be reviewed in the complete report of the meeting in next week's *Chem. & Met.*

Two short business sessions were productive of several important announcements and committee reports. Reporting for the Council, Secretary Olsen announced that the winter meeting will be held in Pittsburgh, December 3-6, 1924, and that the Institute has agreed to hold the following meeting in Providence, R. I., during the week of June 20, 1925. This is at the time of the exposition of the Chemical Equipment Manufacturers Association and therefore promises unusual technical attractions. President Charles L. Reese also reported that consideration had been given to the proposition of holding a joint meeting with the British Institution of Chemical Engineers in England during July, 1925, directly following the Providence meeting. Letters were read from the Institution's president, Sir Arthur Duckham and from Secretary Hinchley urging such a joint meeting. Before the arrangement is officially approved it was decided to make a canvas of the members to determine opinion regarding such a meeting for either 1925 or 1926. Of the committee reports those of Crosby Field on identification and covering for pipelines and of W. L. Badger on the evaporator test code were of outstanding technical importance and will be reviewed later in this magazine.

The social features and entertainment provided during the western trip rivals any in the Institute's history. The special party of 75 members and their guests, that left New York July 12 was royally entertained during stopovers in Chicago and Omaha. In Denver an enterprising local committee had made every possible arrangement for showing the visiting engineers the scenic wonders of their city, its mountain parks and splendid drives. That the members were appreciative of this phase of the program is indicated by the fact that Friday's technical session was abandoned in order that all might join on the famous Corona trip to "the top of the world." Saturday about 50 members and their families left Denver for Colorado Springs, Salt Lake City, Yellowstone Park and the Pacific Coast.

Distribution of Reparation Dyes in England

The president of the Board of Trade in answer to a question asked recently in the British House of Commons, stated that reparation dyestuffs were distributed in England by the British Dyestuffs Corporation as agents, and under the direction of the Board of Trade, which fixes the prices, with the assistance of an informal committee on which the consumers of dyestuffs are represented. Details as to the quantities of dyestuffs received from time to time are immediately notified to the Colour Users' Association, and such quantities are reserved for a period of seven days for actual users; afterwards they are available for all buyers.

Ceramists Postpone Trip

According to a statement sent out by the American Ceramic Society all plans for the western summer meeting have been postponed because of slack business and the very unusually low steamship rates to Europe making it impossible at this time to secure a representation of eastern ceramists that would measure up to the very fine entertainment which the western members had planned. The trip has therefore been put off by order of President R. D. Landrum in council with F. B. Ortman, general chairman of the summer meeting committee.

Backhaus Patent To Be Used By Canadian Carbonate, Ltd.

Canadian Carbonate, Ltd., having its head office in Montreal and Branch plants at Halifax, Toronto, Hamilton, Winnipeg, Calgary and Vancouver, announce the purchase from the United States Industrial Alcohol Co. of New York of the Backhaus patent for use in Canada. The Backhaus patent covers a process for purifying carbonic acid gas recovered from the distillation of grain or molasses, which with the coke process at present in use, will enable the company to satisfy the requirements of all its customers.

Canadian Carbonate, Ltd., are now completing arrangements for installations to use the process in Montreal and Calgary, and later on will gradually use the process in conjunction with their present process in their plants throughout Canada.

Canadian Carbonate, Ltd., have, for some years, been the largest manufacturers of carbonic acid gas in the British Empire, and have extended their export business to the Orient and South America.

Riordon Co., Ltd., Announces Public Auction of Assets

An important development in the pulp and paper situation in Canada is the announcement by the Riordon Co., Ltd., that its entire assets will be sold by public auction. The sale will take place in Montreal and is under authority from the winding-up court by which the liquidator, Gordon Scott, will unite with the Montreal Trust Co. as trustee for the eight per cent bonds, and the Royal Trust Co., as trustee for the six per cent general mortgage bonds, in selling all the Riordon properties.

For convenience the sale of properties are divided into "parcels" 14 in number, many of which are divided into sub-parcels and each of such parcels is offered, not only as an entirety, but also by separate sub-parcels.

In addition the properties are also offered in three groups of parcels, each group including related properties or those that could be considered as having a bearing on one another.

The deposits from bidders have been placed at low figures in order that as wide bidding as possible may be secured.

Use of Chlorine May Be Expanded in Sewage Disposal

The chemical agencies in the Government establishment are anxious to cooperate in any of the various efforts being made by industry to expand the use of its product or byproducts. The organized effort recently undertaken to increase the use of chlorine is cited as typical of the trend along such lines. In that connection, the thought is expressed that one great potential field for chlorine is in sewage disposal. Before many months the Supreme Court of the United States is expected to rule as to the legality of the present diversion of water from Lake Michigan at Chicago. Should this case be decided adversely to the contentions of the Chicago sanitary authorities, the use of chlorine for large-scale sewage disposal would offer the most effective solution of the problem, it is believed. It is estimated that there are literally thousands of municipalities in the country which could dispose of their sewage by the chlorine method in a more effective and cheaper way than that now employed. While no particular study of this problem has been made at any of the chemical bureaus, some of the Government's chemists think it is within the range of practicability to extend this use of chlorine to farms and the small towns not provided with a sewerage system.

Oklahoma University to Give Petroleum Engineering Course

Petroleum engineering will rank with other major engineering courses in the University of Oklahoma with the beginning of the next school year. H. C. George, whose resignation from the staff of the U. S. Bureau of Mines has recently been announced, will have charge of the new course with the title of professor of petroleum engineering. In the past the University of Oklahoma, like practically all the universities of other states, has paid little attention to the production division of the oil industry except as to geology. The chemistry of petroleum has received considerable treatment, but the business of handling producing leases has been all but neglected. The new major subject of petroleum engineering is planned to be one of the strongest engineering courses offered, as is proper, considering the state's position as an oil producer. Oklahoma will be the third to offer such a course. The other two are the Universities of California and Pittsburgh.

Employees Secure Control of Devoe & Raynolds Co.

Sixteen employees of the Devoe & Raynolds Co., manufacturers of paints, varnishes, brushes, artists' materials, insecticides, etc., have bought out the controlling interest of the old stockholders of the company. The new officers are: E. S. Phillips, president, who started with the company as a retail clerk; E. D. Peck, vice-president and general manager, who joined the company as a road salesman; De Lancey Kountze, treasurer; P. le B. Gardner, vice-president and director of sales; A. C. Stephan, vice-president and director of administration; E. S. Blackledge, vice-president and director of plants; E. B. Prindle, vice-president; G. H. Phillips, vice-president; S. R. Harrington, vice-president, and A. F. Adams, secretary.

Dyestuffs Trade of Scotland

The production of coal-tar crudes is carried on to a limited extent at a chemical plant in Aberdeen and at the gas works of some of the cities and towns, but there is no manufacturing of intermediates and dyestuffs in the vicinity of Dundee. Consul H. A. Johnson says the chemical works in Aberdeen produce benzol, toluol, and naphthalene, and although they formerly manufactured phenol and cresol, the higher distillation products are now sold in the crude state to manufacturers in England. The firm likewise markets solvent naphtha as do other institutions in Burghead, Elgin, Inverness, and Perth.

Although no dyestuffs are produced in this vicinity, their consumption is quite extensive, as large quantities are required for the coloring of jute goods, such as burlays, Hessian cloths, and carpets, the manufacture of which is carried on in Dundee on a large scale. In that there are over 60 manufacturers of jute goods in the vicinity, this industry is the most important consumer of dyes. Second in importance are the 25 firms engaged in the manufacture of linen goods. Practically no cotton and very little woolen goods are made in the district. There are a few paper manufacturers, but no leather producers. Comparatively few of the textile manufacturers do their own dyeing and it is of interest to note that the Jute Industries, (Ltd.), an association of several individual jute manufacturers, is about to establish a large dyeing plant for their own use.

Cottonseed Oil Investigation Will Begin August 1

Field investigations for the purpose of gathering the necessary figures on cottonseed oil to enable the Tariff Commission to pass upon the application for a reduction in the duties on vegetable oils will be begun August 1. The investigators who have been sent to Japan, China and Manchuria will not be able to report before December 1, it is believed. Soap makers and other consumers of vegetable oils feel confident that they will be able to establish that the present level of duty rates is not justified. They are emphasizing the point that the rate of duty has a very different effect on an industry in which raw materials constitute three-fourths of the cost of the finished commodity, than it does on an industry where dutiable ingredients constitute a small fraction of the total cost of the finished product.

Decline in Production of Crude Oil in California

State Oil and Gas Supervisor R. D. Bush reports that production of crude oil in California for the first half of the current year was 118,113,000 bbl., compared with 146,338,069 bbl. in the last half of 1923, a decline of 28,225,000 bbl. Average daily production January 1 was 700,300 barrels, declining to 619,500 barrels on July 1, and shows steady decline from peak in the fall of last year.

While production decline has been gradual, the slump in the three big fields of Los Angeles basin, which produced the major portion of the oil, has been marked. Consumption also declined, but more rapidly than production, with the result that storage increased from about 92,000,000 barrels on January 1, 1924, to 100,000,000 barrels at the end of June.

Swedish Chemical Market More Active in June

A report from Stockholm says that the chemical market there during June was considerably livelier than in May. Prices were practically unchanged but there was a falling tendency. The quotations for waxes reached their culminating point and are now declining. The only increases in price worth mentioning were in lead colors. A very lively demand for articles for use in connection with house-building, including colors, is expected in July. It is possible that the demand for other articles may be livelier than might be expected at this season of the year as certain requirements remain uncovered owing to the late spring.

Financial

The directors of the Commercial Solvents Corporation have declared a dividend of $1 a share on the class A stock. The dividend is for the first quarter of 1923 and reduces the back dividends due on this issue to $2 a share.

The Endicott Johnson Corporation reports net sales of $31,460,500 for the first half of 1924, against $33,478,170 in the same period of 1923. The net profit for the first half of this year, after preferred dividends, was equal to $3.13 a share earned on the $20,253,000 common stock of $50 a share par value outstanding.

Bay Sulphite Co. bondholders meet in Montreal, July 16, to consider sale of company to new organization, Port Alfred Pulp & Paper Co., involving exchange of Bay Sulphite bonds for those of new company.

Beech-Nut Packing Co. for 6 months ended June 30, 1924, reports net earnings of $1,178,114 before taxes, comparing with $1,215,030 in first half of 1923. Sales for first 6 months showed an increase of 8.5 per cent as compared with first half of 1923.

The directors of the Sinclair Consolidated Oil Corporation have declared the regular quarterly dividend of $2 a share on the preferred but passed the quarterly dividend of 50c. per share on the common. In explanation of the latter it was stated that it was the opinion of the directors that for the best interests of stockholders, cash should be conserved during the present period of uncertainty in the oil industry.

A plan and agreement has been formulated by the adjustment committee representing the bondholders of Indiahoma Refining Co. for the acquisition of the assets of that company which has been in receivership since November, 1923.

The Bigelow Hartford Carpet Co. has declared regular quarterly dividends of $1.50 on the common and $1.50 on the preferred, both payable August 1 to stock of record July 18.

Increase in Production of Writing Inks

The Department of Commerce announces that, according to data collected at the biennial Census of Manufacturers, 1923, the establishments engaged primarily in the manufacture of writing inks reported products valued at $6,107,379, of which amount $1,874,255 represents products other than writing inks, principally mucilage, other adhesives, and carbon paper. The rate of increase in the total value of products as compared with 1921, the last preceding census year, was 22.6 per cent. Establishments engaged primarily in other industries reported the manufacture of writing inks valued at $179,455 in 1921. The value of writing inks reported by such establishments for 1923 has not yet been ascertained but will be shown in a subsequent report.

Southern California Chemists Elect Officers

At a special meeting of the Southern California section of the American Chemical Society, held on June 27 at Los Angeles, the following were declared elected for the ensuing year: Chairman, William C. Morgan; secretary, Mark Walker; treasurer, C. J. Marvin; councilors, W. A. Schmidt, H. L. Payne and S. J. Bates. The awards of the high-school contest in chemistry, in which 22 institutions were represented, were announced as follows: Winning team, silver cup, Long Beach High School, for the second year in succession, with the following team —L. Brown, J. Levine, G. Newman, E. Merwin and T. Vasey. The three students making the highest individual awards, elected to associate membership of the section for the ensuing year, were G. Harness, G. Taylor and L. Brown. The speaker of the evening was H. C. Parmelee, editor of *Chem. & Met.* the subject of whose address was "Chemical Engineering in Industry."

Russian Glass Producers Seek Increased Output

At a conference of trusts of the glass and pottery industries in Russia, according to a recent Reuter dispatch, it was agreed that an increase in the production program for the coming year 1924-25 was quite possible in view of the state of the market but that the final settlement of this question would have to be deferred until the results of the harvest became clearer. The increase in production, in any case, would have to be effected by increasing the capacity of already existing enterprises.

The only method of rendering the glass and pottery industry more profitable was by the introduction of more rational methods of production except in the case of apothecaries' glass, the prices for which must be raised. In order to rationalise production it was found necessary to introduce mechanical means of production, except in cases where this would lead to specially heavy expenditure.

Calendar

AMERICAN CERAMIC SOCIETY, summer meeting and tour, July 21 to Aug. 13.

AMERICAN CHEMICAL SOCIETY, sixty-eighth meeting, Cornell University, Ithaca, N. Y., Sept. 8 to 13.

AMERICAN ELECTROCHEMICAL SOCIETY, Detroit, Oct. 2 to 4.

AMERICAN FOUNDRYMEN'S ASSOCIATION, Milwaukee, Wis., Oct. 11 to 16, 1924.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, Birmingham, Ala., Oct. 13 to 15.

AMERICAN SOCIETY FOR STEEL TREATING, Boston, Sept. 22 to 26.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, Toronto, Aug. 6 to 13.

INTERNATIONAL MATHEMATICAL CONGRESS, Toronto, Aug. 11 to 16.

MANAGEMENT WEEK. Auspices of American Society of Mechanical Engineers, New York City, Oct. 20 to 25.

NATIONAL SAFETY COUNCIL, thirteenth annual congress, Louisville, Ky., Sept. 29 to Oct. 3.

PACIFIC COAST GAS ASSOCIATION, Santa Barbara, Calif., Sept. 15 to 19.

Personal

RICHARD BAYBUTT, general manager of the Hub Dyestuff & Chemical Co., South Boston, Mass., is abroad, visiting England and points on the Continent, and expects to return to his office late in August.

Prof. W. L. DEBAUFRE, of the University of Nebraska, is in Washington to acquaint the Board of Helium Engineers, of which he is a member, with the results of some of his recent studies.

HARRY B. DEPONT, formerly chief chemist for the Michigan Portland Cement Co., of Chelsea, Mich., is now chief chemist for the Manitowoc Portland Cement Co., at Manitowoc, Wis.

W. R. FAWCETT has been appointed secretary and treasurer of the Pacific Clay Products Co., Inc., Los Angeles, Calif., succeeding W. G. Brady, resigned.

Edmondson, Washington, D. C.

Guy C. Riddell

W. H. GRAY, of Tulsa, Okla., president of the National Association of Independent Oil Men, gave an address before the members of the petroleum bureau of the Chamber of Commerce, Fort Worth, Tex., July 7.

DALLAS D. HUGHEY, adviser to the mechanical department at the plant of the Illinois Glass Co., Alton, Ill., has resigned. He has been connected with the company for the past 25 years.

Dr. S. C. LIND, chief chemist of the Bureau of Mines, is paying inspection visits to the bureau's stations at Pittsburgh and Columbus, Ohio.

D. S. MACBRIDE, heretofore district engineer for the Portland Cement Association at Philadelphia, Pa., has resigned, to become connected with the International Cement Corporation, New York.

HUGH K. MOORE, of the Brown Co., Berlin, N. H., received the honorary degree of Doctor of Science from the University of Maine on June 9.

GUY C. RIDDELL, mining engineer and metallurgist, has recently been appointed to take charge of the new federal mineral division of the Bureau of Foreign and Domestic Commerce. Until recently Mr. Riddell has been with the Wah Chang Trading Corporation in New York.

AUGUST STAUDT, president of the Perth Amboy Tile Works, Perth Amboy, N. J., and vice-president of the American Ceramic Society, has sailed for Europe for a pleasure trip, accompanied by his wife and daughter.

ADOLPH STUBER, general manager of the camera works and research laboratories of the Eastman Kodak Co., Rochester, N. Y., has been appointed to the board of directorate of the Union Trust Co., Rochester, N. Y.

At the recent annual meeting of the Pennsylvania Grade Crude Oil Association, E. C. BREENE, of Oil City, Pa., was elected president; J. P. FLYNN, of Sisterville, W. Va., vice-president; E. M. Lyons, of Philadelphia, Pa., recording secretary; S. MESSER, of Oil City, Pa., treasurer, and R. J. ALEXANDER, also of Oil City, general secretary.

Obituary

WILFRED DODDS, vice-president of the Penman-Littlehales Chemical Co., Syracuse, N. Y., was fatally injured by the collapse of a temporary stairway at the company's plant, July 10. He was supervising work in connection with the reopening of the factory, after a shut-down. He was 40 years of age.

Dr. JOSEPH C. HAAS, of Philadelphia, Pa., a well-known chemist, died at St. Luke's Hospital in that city, July 8, aged 56 years. He was born in Alsace, and received the major part of his education abroad. He is survived by his wife, one son and a daughter.

BENJAMIN G. LAMME, chief engineer of the Westinghouse Electric & Manufacturing Co. and one of the world's leading electrical authorities, died at East Liberty, Pa., on July 8, after a lingering illness. Mr. Lamme was born near Springfield, Ohio, Jan. 12, 1864. In 1888 he was graduated from Ohio State University in mechanical engineering, there being at that time no course in electrical engineering, the subject that interested him most. Entering the employ of the Westinghouse Electric Co. in 1889 at $30 a month, his skill in calculating and designing electrical equipment was soon recognized and in 1903 he became chief engineer. His most spectacular designing achievements were: The single-reduction-gear street-car motor, which, though designed in 1890, is the type still used on street railway systems; the generating equipment for the World's Fair in Chicago in 1892; the 5,000-hp. generators that first harnessed Niagara Falls; the single-phase alternating current high-voltage system of railroad electrification; and the most successful synchronous converter ever used. He also conceived the idea that led to the development of the squirrel-cage induction motor.

Market Conditions

Scattered Buying Marks Trading in Chemical Products

New Business Is Not Consistent—Contract Withdrawals Show Slight Gain—Prices Move Within Narrow Limits

IMPROVEMENT in call for deliveries against contracts was reported for some of the basic chemicals but new orders were not heavy during the past week. The position of consuming trades is gaining materially and with consumers carrying small stocks the market would be sensitive to an increase in buying. One of the leading chemical companies in a statement to the trade, expressed the view that they anticipated no price fluctuations of any account for the present, unless an unexpected demand should arise, causing a shortage due to producers running too close.

While there has been smaller distribution of chemicals among the consuming industries of this country, it is evident from a study of export statistics that foreign markets have failed to buy up to the standards of last year. For the first 5 months of this year exports of chemicals and allied products show a loss of approximately $4,000,000 as compared with the corresponding period of 1923. The comparison is still more unfavorable if confined to the soda group as exports this year were almost 25 per cent in volume, below those of 1923. It is clear, therefore, that loss of export trade has contributed materially to the curtailment of chemical manufacture in this country.

The weighted index for the week moved upward rather sharply. The advance depended largely on higher markets for basic vegetable oils and allied products and not on price fluctuations in the purely chemical list. The latter show no decided price tendency and generally speaking market values are easy because buying activity is too irregular to remove selling pressure.

Holders of arsenic are watching the movement of calcium arsenate but the latter appears to have worked into a position where it is beyond recovery. Some producers of arsenate are clinging to the policy of selling without respect to cost prices and others have the choice of following suit or of holding stocks indefinitely. It is worthy of note that the arsenic market has held steady in price in recent weeks and apparently the bottom has been reached.

Acids

In contrast to the general chemical list, exports of acids in the first 5 months of the year, registered a small gain in volume over those for the corresponding period of 1923. Hence the slower position of most offerings has been due to local conditions, either falling off in domestic consumption or greater competition from imported acids. Imported tartaric acid still dominates the market with demand of fair proportions. The preference of buyers of citric acid is now with the domestic product because recent declines in price have placed the home material on an equal footing with the imported. Oxalic acid is irregular in price with reports that both foreign and domestic are openly offered at 9¾c. per lb. Some dissatisfaction has been voiced because no decision regarding tariff changes on oxalic acid, has been announced but Washington advices say it is probable that a report will not be made to the President before September. Sulphuric acid has maintained an easy tone with prices for all strengths largely a matter of private negotiation. Stocks are large enough to hold the market under pressure and firm prices can hardly be expected before the surplus in sellers hands has been reduced. Other mineral acids are in a position similar to sulphur and prices show the same irregularity.

Bichromate of Potash Weak—Sal Ammoniac Firmer — Nitrite of Soda Steady—Arsenic Quiet and Steady — Copper Sulphate Easy—Oxalic Acid Unsettled — Sulphuric Acid Irregular in Price—Nitrate of Soda in Limited Supply—No Improvement in Calcium Arsenate

Potashes

Bichromate of Potash—Sellers have been prominent and buyers have been favored by the weakness in price. In some quarters the open quotation is held at 9¼c. per lb., but it was possible to pick up material last week as low as 9c. per lb. and in some quarters 9¼c. per lb. was an open price. Export trade has fallen off from last year's standards and domestic buyers have not been operating actively.

Bicarbonate of Potash — Quiet call from consumers has developed an easy price tendency. Holders of stocks have been open to bids and prices of 10¼@10¾c. per lb. have been current.

Carbonate of Potash—Offerings are fairly freely with buying interest confined to small lot transactions. The quoted prices might be shaded on desirable business but sellers made no open changes and continued to ask 6c. and upward for calcined 96-98 per cent; 5¾@6c. for 80-85 per cent; and 5¾@6c. for hydrated.

Chlorate of Potash—Large consumers continue to take deliveries of imported chlorate against contracts and spot holdings of good grade material are reported to be moderate. Asking prices are 7@7¼c. per lb. for spot with the inside figure quoted for shipments.

Caustic Potash — Offerings at 6¼c. per lb. on spot seemed to be more numerous than in the preceding week but 6¾c. per lb. is still asked by some importers. Forward positions are held on a parity with the spot market as shipments from abroad were offered at 6¼c. per lb.

Permanganate of Potash—Moderate sized lots are said to have changed hands at 14c. per lb. There is a lack of trading in large lots and whereas 14c. per lb. is the lowest quotation of sellers, it is intimated that this figure would be shaded on round lots.

Prussiate of Potash — There were sales of yellow prussiate of potash in the spot market at 18½c. per lb. This price is generally quoted as an inside figure but reports are heard that as low as 18c. per lb. has been quoted. Shipments from Europe are held at 18c. per lb. Red prussiate is not moving to any extent and former quotations of 37½@40c. per lb. still hold good.

Sodas

Bichromate of Soda—The soda product was more firmly held than bichromate of potash and the lowest price heard was 7½c. per lb. Some producers are not carrying large stocks and show a tendency to hold prices at an inside figure of 7¼c. per lb. Competition is keen whenever buying orders are in evidence and this prevents a stable market.

Caustic Soda—Contract withdrawals are said to have picked up in volume but the market is going along in a quiet way. New business is of moderate proportions and export buying is not heavy. Price cutting is not prominent and first hands continue to quote $3.10 per 100 lb. for carlots at works, on contracts. Prices for export show a range according to seller and destination of shipment with $2.85@$3 per 100 lb. covering the range of quotations.

Chlorate of Soda—Domestic chlorate has been more prominent and reports have been heard to the effect that competition among domestic producers might become keener. The price tone has been easy and domestic material was offered at 6¼c. per lb. at works.

Imported chlorate is quiet with spot holdings at 6¾c. per lb.

Cyanide of Soda—This material has been featured by a heavy export demand and outward shipments for the 11 months ended May have more than doubled those for the corresponding period last year. Imports of cyanide also have run ahead of last year with low grade material reported to predominate. Prices for cyanide in the local market vary according to quality with 20@22c. per lb. prevailing for prime goods.

Fluoride of Soda—Very little interest has been shown in this material and buying is said to have been too slow to test values. Sellers have not been pushing matters and have held quotations at 8½c. per lb.

Nitrate of Soda—Offerings of nearby material have taken away interest from strictly spot goods and values have failed to hold a firm position. Spot nitrate is well cleaned up but scattered offerings are to be had around $2.45 per 100 lb. and arrival the latter part of the month is available at the same figure.

Nitrite of Soda—The increase in import duty has not brought domestic manufacturers to the fore and 9c. per lb. at works is the quotation of some producers. Imported nitrite varies in price according to seller. Norwegian is quoted at 9c. per lb. and other grades at 8½@8¾c. per lb.

Prussiate of Soda—Sales of prussiate went through during the past week at 9¾c. per lb. for spot material. In most cases 9½c. per lb. was established as an inside price. Shipments of imported prussiate were offered at 9¾c. per lb. Buying interest was inactive and no round lot business was reported.

Miscellaneous Chemicals

Arsenic — Demand for arsenic was again slow but prices held on a steady basis. Domestic arsenic for delivery over the balance of the year was offered at 7¾c. per lb. Imported arsenic also was held at 7¾c. per lb. on spot with a premium asked for small lots. One domestic producer announced that hereafter the product of the company would be sold direct instead of through sales agents as heretofore.

Barium Chloride — There have been reports that spot goods could be bought at $78 per ton but inquiry at that price found no sellers and $79 per ton is given as a firm quotation. On shipments from abroad $78 per ton can be done. Barium carbonate is quiet with goods held at $60@$61 per ton.

Calcium Arsenate—There were open quotations of 9¾c. per lb. delivered at southern points but 9½c. per lb. has been done and with the market carrying a heavy surplus there is little chance for stable prices. At works 9c. per lb. can be done on carlots. With the buying season drawing to a close, the outlook from the producers viewpoint is far from satisfactory and losses are sure to be recorded by manufacturers. The government still predicts a bright future for arsenate but holds that educational work is necessary to increase consumption.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	157.82
Last week	156.06
July, 1923	171.00
July, 1922	156.00
July, 1921	148.00
July, 1920	274.00
July, 1919	231.00
July, 1918	277.00

Higher prices obtained for cottonseed oil, linseed oil and refined glycerine, which offset declines in miscellaneous chemicals, the result being a net gain of 176 points in the weighted index number.

Copper Sulphate—A good part of the buying is said to be over and as stocks are still ample, the market is subjected to some pressure to reduce holdings. Domestic sulphate was reported to have been offered as low as 4.30c. per lb. The price for domestic varies according to seller with up to 4.60c. per lb. asked. Imported was dull with spot nominal and shipments at 4½c. per lb.

Sal Ammoniac — More interest was shown by consumers and firmer markets abroad were indicated in cable advices. Scattered lots on spot were available at 6¾c. per lb. but many holders advanced their views to 6½c. per lb. and the latter price was more general toward the close of the week. Shipments were quoted at 6½c. per lb.

Alcohol

There is a firmer tendency to prices for basic materials and this has brought out a better feeling in the market for denatured alcohol. The demand has shown improvement. Prices are quotably unchanged, formula No. 1, special denatured, holding at 43c. per gal., in drums, carload lots.

The market for methanol was a featureless affair. First hands were sellers of pure at 75c. per gal., tank cars, 78c. per gal., in drums, and 83c. per gal., in bbl.

Some important contracts have been placed in butyl alcohol at private terms. The open market held at 25c. per lb.

Coal-Tar Products

Steady Call for Benzene at Unchanged Prices—Phenol Unsettled—Refined Naphthalene Easy—Creosote Lower Abroad

BUSINESS placed in the market for benzene was sufficient to absorb surplus production and the undertone continued firm in all directions. The decline in prices for motor gasoline attracted some attention, but failed to affect the general situation. Producers of benzene regard the outlook as favoring sellers as indications do not point to any immediate revival in the steel industry. Refined naphthalene underwent no change for the better, prices presenting an easy undertone. U.S.P. phenol was inactive and scattered lots were available for nearby delivery at slight concessions. Pyridine was unsettled on freer offerings from abroad. Advices from English markets reported lower prices for creosote oil.

Aniline Oil and Salt—No change took place in the selling basis, first hands reporting scattered business at 16c. per lb., drums extra, carload lots. Aniline oil for red was nominal at 40c. per lb., with the price barely steady. Aniline salt held at 22@23c. per lb.

Benzyl Chloride—There was a fair inquiry for the technical grade for which first hands asked 25c. per lb., in drums. On the 95-97 per cent material 35c. represented the market.

Benzene—With stocks barely sufficient to meet requirements prices on all grades were firmly maintained. Leading producers quote 23c. per gal. on the 90 per cent grade and 25c. per gal. on the pure, tank cars, f.o.b. works. Exports of benzene from the United Kingdom for the 5 months ended May 31 amounted to 551,094 gal., which compares with 317,220 gal. for the corresponding period a year ago.

Creosote—According to advices from Manchester American buyers have been holding off from placing any orders and this has weakened the market for creosote oil. There are sellers on the bulk basis of 6½d. per gal., ex plant. Exports of creosote and tar oil from the United Kingdom for the 5 months ended May 31 amounted to 16,676,804 gal., which compares with 17,626,538 gal. for the corresponding period a year ago.

Cresylic Acid—Offerings were liberal enough to bring out irregularity in prices quoted. Business was described as routine only. Quotations ranged from 63@68c. per gal. on the 97 per cent grade. Manchester, England, quotes cresylic acid nominally at 2s. per gal.

Naphthalene—Further weakness was in evidence in the market for refined, flake being available at 4¾@5½c. per lb., the price depending upon the seller and quantity. Chipped naphthalene, white, was offered at 4½c. per lb., carload basis, with the undertone easy. Crude of good quality was offered for shipment from abroad at 2c. per lb., c.i.f. basis. Arrivals of foreign goods have been smaller, reflecting rather poor trading conditions in this commodity.

Paranitraniline — Most traders held out for 68@70c. per lb., in bbl., immediate shipment, but it was reported that slightly better could have been done on a round lot. Demand was quiet and the undertone barely steady.

Phenol — The market was a quiet affair, with prices unsettled in some quarters. Small lots of U.S.P. goods sold on spot at 26c. per lb. Nearby material, in drums, could have been secured at 25c. per lb.

Pyridine—Spot material was available at $3.75@$4 per gal. Offerings from abroad increased, but prospective buyers could not be interested.

Xylidine — The market was easier, closing prices ranging from 45@48c. per lb., in drums.

Vegetable Oils and Fats

Crude and Refined Cottonseed Advance—Linseed Oil Higher on Sharp Uplift in Seed—Corn and Rapeseed Oils Strong

SPECULATIVE activity in refined cottonseed oil, inspired largely by bullish developments in grains and provisions, sent prices higher. Crop news from the Northwest was unfavorable and this led to a more active and strong market for flaxseed. Before the close of the week crushers announced a higher selling basis for linseed oil. China wood oil was less active and unsettled. Crude corn and refined rapeseed oils were higher. Good trading took place in refined sesame oil for shipment from abroad. Tallow and greases ruled firm.

Cottonseed Oil—The movement of refined cottonseed oil into consuming channels was up to expectations and speculators playing the long side of the market had things pretty much their own way. Grains advanced sharply, and, with lard in Chicago also higher, the cottonseed oil options established new highs for the movement. Statistically the market is strong. Conservative traders believe that the bullish statistics are discounted by prevailing prices, but admit that the situtation favors holders of actual oil as the speculative element now is in control of many of the commodity markets. On Thursday July refined oil on the Produce Exchange settled at 12.30c. per lb. bid and 13c. per lb. asked, in bbl. October oil was offered at 11.29c. per lb. Crude cottonseed oil was nominal at 10@10¼c. per lb., tank cars, f.o.b. mills, the top price prevailing in most directions; offerings were small. Bleachable oil was nominal at 11@11¼c. per lb., tank cars, f.o.b. Texas common points. Lard compound was advanced to 13¼c. per lb., carload lots. Pure lard in Chicago on Thursday settled at 12.45c. per lb. Stocks of lard in the Chicago district on July 15 amounted to 98,404,517 lb., which compares with 92,002,701 lb. on July 1.

Linseed Oil—The Northwestern seed markets advanced fully 20c. per bu. in the past week. This resulted from activity mostly speculative in character, unfavorable crop news on grains in general causing wild excitement in the leading grain centers. July flaxseed at Duluth, on Thursday, stood at $2.57 per bu., with October at $2.40. Canadian crop news was bad and for a time the Winnipeg option market was even higher than Duluth. Linseed oil was raised 2c. per gal., prompt shipment settling around 98c. per gal., in bbl., carload basis. Demand for oil improved slightly and early in the week August business was accepted by crushers at 94c. per gal., cooperage basis, carload lots. On last quarter deliveries prices heard ranged from 87@92c. per gal., depending upon the seller. Importers of oil showed more interest in the situation, but, so far as could be learned, no important business in foreign oil was placed in the past week. The advance in corn strengthened sellers' views in linseed cake. Trading took place in cake for export at $41 per ton, f.a.s. New York. Flaxseed for September shipment from the Argentine was cabled at $2.00¾ per bu. on Thursday, but offerings of seed now afloat at $2.20 c.i.f. New York found no buyers.

China Wood Oil—Demand came chiefly from dealers. One lot of china wood oil was taken by a varnish maker at 14c. per lb., in bbl., prompt shipment from New York. On the Pacific coast 12¼c. was the nominal quotation for oil in tank cars, nearby positions, with a possibility of doing 12¾c. per lb. for oil in cooperage, prompt shipment. Prices were unsettled.

Coconut Oil—Resale Manila oil sold at 8c. per lb., tank cars, f.o.b. Pacific coast. Later bids at this figure were turned down, holders asking from 8¼@8¼c. per lb., Ceylon type oil, according to delivery. In New York tank car shipments held at 8⅝@8¾c. per lb., asked, immediate delivery.

Palm Oil Imports for 11 Months Decline

Imports of palm oil for the 11 months ended May 31 show a drop of 22,761,740 lb. compared with the corresponding period a year ago. Imports of vegetable oils for the 11 months' period, with a comparison, follow:

	1924	1923
China Wood, lb.	74,378,150	78,026,385
Coconut, lb.	149,351,652	194,194,771
Olive, edible, lb.	75,390,153	66,085,793
Olive foots, lb.	*13,741,125	
Palm, lb.	80,256,788	103,018,528
Palm kernel, lb.	*773,910	
Peanut, lb.	10,389,904	5,724,625
Rapeseed, gal.	1,722,301	1,671,462
Linseed, lb.	17,465,779	46,606,960
Soya bean, lb.	17,590,932	31,142,835

* Beginning Jan. 1, 1924.

Corn Oil—Sales took place early in the week at 10c. per lb., tank cars, Chicago. Later there were buyers at 10¼c. per lb., same terms. The market was strong in sympathy with cottonseed oil.

Palm Oils—The market was firm, but not much trading took place. Lagos oil was offered at 7⅞@7¾c. per lb., as to acidity. Niger was raised to 7¼c. per lb., c.i.f., New York.

Rapeseed Oil—Refined oil on spot was advanced at 80@81c. per gal. The shipment price was advanced to 82½c. per gal. There was a good inquiry for futures, but bids were below the market.

Sesame Oil—Several round lots were taken out of the market. Refined oil settled at 11.60c. per lb., in bbl., prompt shipment from abroad.

Soya Bean Oil—August shipment from the Pacific coast was firm at 10¼c. per lb., duty paid, sellers' tank cars.

Fish Oils—Crude menhaden oil was firmer on unfavorable news regarding fishing operations and 40c. was the nominal quotation at the close. Trading was quiet. English cod oil was offered for shipment at 55c. per gal.

Tallow, Etc.—Extra special tallow was firm at 7¼c. bid. Yellow grease was advanced to 7@7¼c., with white hog grease at 10c. asked. Oleo stearine was nominal at 13c. per lb. No. 1 oleo oil was higher at 14¼c. per lb.

Miscellaneous Materials

Antimony — Market inactive, but prices steady. Chinese antimony on spot 8¼@8⅝c. per lb. Cookson's "C" grade lower at 11¼c. per lb. Chinese needle, lump, nominal at 8¼@9c. per lb.

Glycerine—Sales of crude soap lye glycerine, basis 80 per cent, loose, were reported at 10¾c. per lb., Middle West. Dynamite offered at 16¼c. per lb., in drums, carload lots, with bids at 16¼c. Chemically pure was raised to 16¾@17c. per lb., carload lots, f.o.b. New York.

Lithopone—Competition for contracts now pending is keen and with some factors ready to make slight concessions the market appears unsettled. Leading makers quote 6¼c. per lb., in bags, carload lots, prompt and forward shipment.

Naval Stores—There was a better call for turpentine from domestic consumers, but prices underwent no change, sales passing at 83c. per gal., in bbl. Rosins are moving against existing contracts in a fairly large way, but new business continued slow. The lower grades held at $5.50@$5.60 per bbl.

White Lead—Reports on the condition of the market are conflicting. Some sellers appear anxious for business and intimate that round lots might go through at a moderate decline in price. Leading makers, however, reported steady trading conditions and repeated prices on the basis of 9¾c. per lb. on standard dry white lead, in casks or bbl., carload lots.

Zinc Oxide—Producers made a slight change in the selling schedule, doing away with the premium asked on spot material. In other words spot is now available at a decline of ¼@½c. per lb., depending on the grade. American process lead free is offered at 7½c. per lb., with the lead sulphate 6⅝@6¾c. per lb., in bags, carload lots. French process, red seal, 9⅝c., green seal 10⅝c. and white seal 11¾c. per lb.

American Smelting & Refining Co. To Sell Arsenic Direct

H. M. Brush, vice-president and manager of the sales department of the American Smelting & Refining Co., has announced that the company will market direct its production of arsenic. Mr. Brush stated that through the recent death of Mr. Hugh Hill of Edward Hill's Son & Co. his company had experienced a very great loss. The firm of Edward Hill's Son & Co. had for many years sold all of the arsenic produced by the American Smelting & Refining Co.

Mr. Brush announced that owing to the fact that the firm of Edward Hill's Son & Co. has been automatically dissolved on Mr. Hill's death it is the intention of his company to assume the sale of white arsenic. Arsenic sales will be under the direct charge of L. G. Matthews assisted by L. H. Sonneborn.

Imports at the Port of New York

July 11 to July 17

ACIDS—Formic—84 carboys, Rotterdam, Seaboard National Bank. **Oxalic**—16 csk., Rotterdam, R. W. Greeff & Co. **Stearic**—20 cs., Rotterdam, M. W. Parsons & Plymouth Organic Lab. **Tartaric**—75 kegs, Rotterdam, W. Benkert & Co.; 40 csk., Rotterdam, Order.

AMMONIUM CARBONATE — 15 csk., Liverpool, J. C. Turner & Co.

ANTIMONY REGULUS—1,000 cs., Hankow, C. Hardy, Inc.; 500 cs., Shanghai, Norton, Lilly Co.; 250 cs., Shanghai, Order.

ARSENIC—100 cs., Kobe, Kuhara Trading Co.; 160 cs., Kobe, Frazer & Co.

ASBESTOS—355 bg., Algoa Bay, Standard Bank of South Africa; 70 bg., London, Asbestoc & Mineral Corp.; 529 bg., London, Order.

BARIUM CHLORIDE—92 csk., Rotterdam, Goldschmidt Corp.

BARYTES—1 lot (in bulk), Bremen, Ore & Chemicals Corp.

BAUXITE—500,000 kilos, Palermo, Order.

BRONZE POWDER — 33 cs., Bremen, Baer Bros.; 10 cs., Bremen, Diamond Dec. **Leaf Co.**

CAMPHOR—200 cs., Shanghai, Hetherman & Co.; 100 cs., refined, Kobe, Stallman & Co.

CHALK—400 tons, London, Baring Bros. & Co.

CHEMICALS—25 bbl., Bremen, Stanley Doggett & Co.; 98 csk. and 80 carboys, Rotterdam, Roessler & Hasslacher Chemical Co.; 61 pkg., Rotterdam, Merck & Co.; 15 cs., Rotterdam, H. A. Metz & Co.; 74 cs., Havre, Equitable Trust Co.; 8 cs., Havre, E. Fougera & Co.; 306 bg., Glasgow, Brown Bros. & Co.; 20 csk., Hamburg, **Eimer & Amend.**

COLORS — 10 csk. dry, Southampton, Sherwin, Williams Co.; 12 pkg. aniline, Rotterdam, H. A. Metz & Co.; 57 pkg. do., Rotterdam, Kuttroff, Pickhardt & Co.; 33 cs. aniline, Rotterdam, J. W. Warnecke Corp.; 7 pkg. do., Rotterdam, Garfield Aniline Works; 13 pkg. do., Rotterdam, Grasselli Chem. Co.; 4 pkg. aniline, Havre, Sandoz Chemical Works; 5 csk. aniline, Hamburg, Franklin Export & Import Corp.

COPPERAS—150 csk., Hamburg, Franklin Export & Import Co.

DIVI-DIVI—443 bg., Maracaibo, American Trading Co.

FULLERS EARTH—550 bg., London, L. A. Salomon & Bros.

GAMBIER—776 cs., Singapore, Order; 306 bg., Singapore, Order.

GLYCERINE—50 dr., Havana, Marx & Rawolle; 14 dr., Liverpool, Order.

GRAPHITE—1,200 csk. Moji, Order; 200 bg., Marseilles, Order.

GUMS — 114 pkg. copal, Singapore, Guaranty Trust Co.; 50 cs. damar, Singapore, Baring Bros. & Co.; 50 bg. copal, Singapore, Chemical National Bank; 64 bg. copal and 100 cs. damar, Singapore, Order; 192 bg. damar, Singapore, Order; 120 bg. karaya, Bombay, British Bank of South America; 349 bg. do., Bombay, Order; 70 pkg. manjak, Barbados, F. W. Glardon; 525 bg. arabic, Port Sudan, Thurston & Braidich; 500 bg. do., Port Sudan, P. E. Anderson; 303 bg. do., Port Sudan, T. M. Duche & Sons; 560 bg. do., Port Sudan, Order; 50 cs. damar, Singapore, Brown Bros. & Co.; 128 bg. do., Singapore, Guaranty Trust Co.; 202 bg. do., Singapore, L. C. Gillespie & Sons; 420 pkg. damar and 100 bg. copal, Singapore, Order; 2,349 bg. arabic, Port Sudan, Order; 267 bg. kauri and 15 cs. do., Auckland, Guaranty Trust Co.; 402 cs. do., Auckland, Baring Bros. & Co.; 10 cs. do., Auckland, Equitable Trust Co.; 20 cs. do., Auckland, Brown Bros. & Co.; 242 bg. do., Auckland, Chemical National Bank; 25 cs. do., Auckland, Irving Bank-Col. Trust Co.; 374 sk. do., Auckland, Chase National Bank; 1,195 pkg., Auckland, Order; 410 bg. copal, Adelaide, Order.

IRON OXIDE — 146 bbl., Malaga, Reichard-Coulston, Inc.; 200 bbl., Malaga, O. J. Osborn Co.; 100 bbl., Malaga, C. J. Osborn Co.; 100 bbl., Malaga, American-Hawaiian S. S. Co.; 211 bbl., Malaga, Smith Chemical Co.; 75 bbl., Malaga, E. M. & F. Waldo; 75 bbl., Malaga, C. K. Williams & Co.; 12 csk., Liverpool, Reichard-Coulston, Inc.; 20 csk., Liverpool, Order.

IRON SILICATE—10 csk., Liverpool, A. Murphy & Co.

MAGNESITE — 313 bg. and 109 csk., Rotterdam, Speiden, Whitfield Co.; 200 csk., Rotterdam, Brown Bros. & Co.

MANGANESE—200 dr., Liverpool, Order.

MYROBALANS—5,948 bg., Bombay, Order; 1,100 bg., Bombay, National City Bank.

OCHER — 244 csk., Marseilles, J. Lee Smith & Co.; 734 bbl., Marseilles, Reichard, Coulston, Inc.; 142 csk., Marseilles, Am. Exchange Natl. Bank; 469 csk., Marseilles, Order.

OILS—China Wood—250 bbl., Hankow, Mitsubishi Shoji Kaisha; 50 dr., Shanghai, Devoe & Reynolds. **Coconut**—993 tons (in bulk), Manila, Spencer Kellogg & Sons. **Herring** — 250 bbl., Kobe, National Oil Products Co. **Linseed**—45 dr., Rotterdam, W. Van Doorn. **Olive Foots** (sulphur oil) —400 bbl., Lisbon, Heidelbach, Ickelheimer & Co. **Peanut**—5 bbl., Rotterdam, Lamont, Corliss & Co. **Perilla**—5 bbl., Dairen, Wilbur, Ellis Co. **Seal**—294 tons (in bulk), St. Johns, Bowring & Co.

OIL SEEDS—Castor—200 bg., Port au Prince, S. L. Brinley; 1,400 bg., Bombay, E. D. Sasson & Co.; 7,000 bg., Bombay, Strauss & Co.; 2,049 bg., Bombay, Volkart Bros.; 15,948 bg., Bombay, Order; 2,239 bg., Calcutta, Order; 2,432 bg., Calcutta, Order. **Copra** — 1,313 bg., Honduras, Franklin Baker Co.; 343 bg., Papeete, Order; 2,871 bg., Raiatea, U. S. Nickel Co. **Linseed**—2,796,049 kilos (in bulk), Santa Fe, Order; 17,150 bg. and 352,486 kilos (in bulk), Rosario, Order.

POTASSIUM SALTS—3,000 bg. muriate, Bremen, Potash Importing Corp. of America; 50 csk. bicarbonte, Rotterdam, Meteor Products Co.; 5 cs. salts, London, Hager Loudeborg Co.; 26 bbl. do., London, Chatham & Phenix National Bank; 10 cs. and 4 dr., Hallstavik, J. W. Hampton, Jr., & Co.

SHELLAC—168 cs., Singapore, Order; 100 bg., Calcutta, British Overseas Bank; 250 bg., Calcutta, Lee, Higginson & Co.; 1,200 bg., Calcutta, Brunswick, Balke, Collender Co.; 200 bg., Calcutta, Brown Bros. & Co.; 110 bg., Calcutta, Bank of the Manhattan Co.; 100 bg., Calcutta, N. Y. Trust Co.; 200 bg., Calcutta, Mechanics & Metals National Bank; 148 pkg., Calcutta, Am. Trust Co.; 100 bg., Calcutta, MacLac Co.; 100 bg., Calcutta, N. Y. Trust Co.; 205 pkg., Calcutta, Marx & Rawolle; 50 bg., Calcutta, Anglo South-Am. Trust Co.; 1,730 bg., Calcutta, Order; 135 cs., Marseilles, Order; 550 pkg., Calcutta, Brown Bros. & Co.; 152 pkg., Calcutta, Marx & Rawolle; 2,799 pkg., Calcutta, Order; 25 chests, London, Order.

SODIUM SALTS — 18 csk. prussiate, Liverpool, Order; 224 dr. and 50 cs. cyanide, Liverpool, Order; 45 csk. prussiate, Liverpool, C. Tennant Sons & Co.; 4 cs. caustic, Hallstavik, J. W. Hampton, Jr., & Co.

TALC—500 bg., Genoa, Coty, Inc.

TALLOW — 150 cs. vegetable, Kobe, Vacuum Oil Co.

TARTAR—1,011 bg., Marseilles, Royal Baking Powder Co.; 477 bg., Marseilles, C. Pfizer & Co.; 231 bg., Genoa, C. Pfizer & Co; 100 bg., Marseilles, Equitable Trust Co.

VALONEA—8,154 bg., Smyrna, Order.

WAXES—800 bg. paraffine, Marseilles, Order; 111 bg. carnauba, Pernambuco, Order; 22 bg. do., Para, Coal & Iron National Bank; 112 bg. do., Para, Order; 3,124 bg. paraffine, London, Asiatic Petroleum Co.; 10 bg. ceresin, Hamburg, Equitable Trust Co.; 101 bg. ceresin, Hamburg, Order; 25 bg. beeswax, Havana, Order.

WOOL GREASE — 100 bbl., Bremen, American Exchange National Bank; 10 bbl., Bremen, Am. Exchange Natl. Bank.

ZINC DUST—100 cs., Moji, Order.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

CARBON BLACK. Hamburg, Germany. Purchase.—10,951.

CARBON BLACK from peach seeds. Havana, Cuba. Purchase.—10.950.

DYES, Bahia, Brazil. Agency.—10,921.

NAVAL STORES, pine tar, pitch and turpentine. Hamburg, Germany. Purchase and agency.—10,947.

PAINTS AND VARNISHES. Bombay, India. Agency.—10,946.

ROSIN. Hamburg, Germany. Purchase.—10,951.

ROSIN. Tokyo, Japan. Purchase.—10,952.

ROSIN AND CAUSTIC SODA. Porto Alegre, Brazil. Agency.—10,954.

FATS for soap manufacturing. Kovno, Lithuania. Purchase.—10,955.

Increased Output of Barytes and Barium Compounds in 1923

There was a notable increase in the output of barytes in the United States in 1923, as shown by statistics compiled by the Geological Survey, and of lithopone and the various barium chemicals, and there was a resultant decrease in the imports of these commodities. On the other hand, the production of ground barytes fell off considerably and the imports were larger.

Crude barytes shipped from mines in the United States in 1923 amounted to 214,183 short tones, valued at $1,664,156, an increase of 38 per cent in quantity and 48 per cent in value over the output in 1922. This output was exceeded only in 1916 and 1920.

Imports of crude barytes in 1923 amounted to 15,045 short tones, worth $93,721 at port of shipment, a decrease of 35 per cent in quantity. A small quantity of barytes was exported to Canada.

The manufacturers of barium products used 210,587 short tones of domestic and imported crude barytes in 1923 in the production of ground barytes, lithopone and barium chemicals. The shipments of ground barytes were 39,605 short tons, valued at $895,095, a decrease of 14 per cent in quantity from 1922. The sales of lithopone were 98,199 short tons, worth $11,608,443, an increase of 18 per cent in quantity. Manufacturers of barium chemicals report the shipment of 16.803 short tons, worth $1,215,596, a quantity 21 per cent larger than in 1922. These chemicals consisted of 6,362 tons of barium carbonate, 3,301 tons of barium chloride, 6.761 tons of barium sulphate and smaller quantities of barium hydroxide and sulphide.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

General Chemicals

Acetone, drums, wks.	lb.	$0.15 –	$0.15½
Acetic anhydride, 85%, dr.	lb.	.34 –	.36
Acid, acetic, 28%, bbl.	100 lb.	3.12 –	3.37
Acetic, 56%, bbl.	100 lb.	5.85 –	6.10
Acetic, 80%, bbl.	100 lb.	8.19 –	8.44
Glacial, 99½%, bbl.	100 lb.	11.01 –	11.51
Boric, bbl.	lb.	.09 –	.09½
Citric, kegs	lb.	.46 –	.46½
Formic, 85%	lb.	.12½–	.13
Gallic, tech.	lb.	.45 –	.50
Hydrofluoric, 52%, carboys	lb.	.11 –	.12
Lactic, 44%, tech., light, bbl.	lb.	.12½–	.13
22% tech., light, bbl.	lb.	.06 –	.06½
Muriatic, 18° tanks	100 lb.	.80 –	.85
Muriatic, 20°, tanks	100 lb.	.95 –	1.00
Nitric, 36°, carboys	lb.	.04 –	.04½
Nitric, 42°, carboys	lb.	.04½–	.05½
Oleum, 20%, tanks	ton	16.00 –	17.00
Oxalic, crystals, bbl.	lb.	.09½–	.10
Phosphoric, 50% carboys	lb.	.07 –	.08
Pyrogallic, resublimed	lb.	1.55 –	1.60
Sulphuric, 60°, tanks	ton	8.00 –	9.00
Sulphuric, 60°, drums	ton	12.00 –	13.00
Sulphuric, 66°, tanks	ton	13.00 –	14.00
Sulphuric, 66° drums	ton	17.00 –	18.00
Tannic, U.S.P., bbl.	lb.	.65 –	.70
Tannic, tech., bbl.	lb.	.45 –	.50
Tartaric, imp., powd., bbl.	lb.	.27 –	.28
Tartaric, domestic, bbl.	lb.	.30 –	....
Tungstic, per lb.	lb.	1.20 –	1.25
Alcohol, butyl, drums, f.o.b. works	lb.	.25 –	.30
Alcohol ethyl (Cologne spirit), bbl.	gal.	4.83 –	....
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.81 –	....
Alcohol, methyl (see Methanol)			
Alcohol, denatured, 190 proof			
No. 1, special bbl.	gal.	.49 –	...
No. 1, 190 proof, special, dr.	gal.	.43 –	...
No. 1, 188 proof, bbl.	gal.	.52 –	...
No. 1, 188 proof, dr.	gal.	.46 –	...
No. 5, 188 proof, bbl.	gal.	.48 –	...
No. 5, 188 proof, dr.	gal.	.42 –	...
Alum, ammonia, lump, bbl.	lb.	.03½–	.04
Potash, lump, bbl.	lb.	.02½–	.03½
Chrome, lump, potash, bbl.	lb.	.05½–	.06
Aluminum sulphate, com., bags	100 lb.	1.35 –	1.40
Iron free bags	lb.	2.35 –	2.45
Aqua ammonia, 26°, drums	lb.	.06½–	.06¾
Ammonia, anhydrous, cyl.	lb.	.28 –	.30
Ammonium carbonate, powd. tech., casks	lb.	.12 –	.13
Ammonium nitrate, tech., casks	lb.	.09 –	.10
Amyl acetate tech., drums	gal.	2.95 –	3.00
Antimony oxide, white, bbl.	lb.	.10 –	.10½
Arsenic, white, powd., bbl.	lb.	.07½–	.08
Arsenic, red, powd., kegs	lb.	.14½–	.15½
Barium carbonate, bbl.	ton	60.00 –	61.00
Barium chloride, bbl.	ton	78.00 –	79.00
Barium dioxide, 88%, drums	lb.	.17½–	.18
Barium nitrate, casks	lb.	.08½–	.08¾
Blanc fixe, dry, bbl.	lb.	.03½–	.04
Bleaching powder, f.o.b. wks., drums	100 lb.	1.90 –	....
Spot N. Y. drums	100 lb.	2.20 –	2.25
Borax, bbl.	lb.	.05 –	.05½
Bromine, cases	lb.	.34 –	.38
Calcium acetate, bags	100 lb.	3.00 –	3.05
Calcium arsenate, dr.	lb.	.09 –	.09½
Calcium carbide, drums	lb.	.05 –	.05½
Calcium chloride, fused, dr. wks.	ton	21.00 –	....
Gran. drums works	ton	27.00 –	....
Calcium phosphate, mono, bbl.	lb.	.06½–	.07½
Camphor, Jap. cases	lb.	.71 –	.72
Carbon bisulphide, drums	lb.	.06 –	.06½
Carbon tetrachloride, drums	lb.	.07 –	.07½
Chalk, precip.—domestic, light, bbl.	lb.	.04½–	.04½
Domestic, heavy, bbl.	lb.	.03½–	.04
Imported, light, bbl.	lb.	.04½–	.05
Chlorine, liquid, tanks, wks.	lb.	.04½–	....
Contract, tanks, wks.	lb.	.04½–	....
Cylinders, 100 lb., wks.	lb.	.05½–	.07½
Chloroform, tech., drums	lb.	.30 –	.32
Cobalt, oxide, bbl.	lb.	2.10 –	2.25
Copperas, bulk, f.o.b. wks.	ton	16.00 –	18.00
Copper carbonate, bbl.	lb.	.15½–	.16
Copper cyanide, drums	lb.	.45 –	.46
Copper sulphate, dom., bbl., 100 lb. Imp bbl.	100 lb.	4.40 –	4.60
Cream of tartar, bbl.	lb.	4.20 –	....
Epsom salt, dom., tech., bbl.	100 lb.	1.75 –	2.00
Epsom salt, imp., tech., bags	100 lb.	1.35 –	1.40
Epsom salt, U.S.P., dom., bbl.	100 lb.	2.10 –	2.35
Ether, U.S.P., dr concent'd.	lb.	.13 –	.14
Ethyl acetate, 85%, drums	gal.	.92 –	.95
Ethyl acetate, 99%, dr.	gal.	$1.08 –	$1.10
Formaldehyde, 40%, bbl.	lb.	.09 –	.09½
Fullers earth—f.o.b. mines	ton	7.50 –	18.00
Furfural, works, bbl.	lb.	.25 –	....
Fusel oil, ref., drums	gal.	2.75 –	3.50
Fusel oil, crude, drums	gal.	1.75 –	2.00
Glaubers salt, wks., bags	100 lb.	1.20 –	1.40
Glaubers salt, imp., bags	100 lb.	.90 –	.92
Glycerine, c.p., drums extra	lb.	.16½–	.17
Glycerine, dynamite, drums	lb.	.16½–	....
Glycerine, crude 80%, loose	lb.	.10½–	.11
Hexamethylene, drums	lb.	.65 –	.70
Lead:			
White, basic carbonate, dry, casks	lb.	.09½–	....
White, basic sulphate, casks	lb.	.09½–	....
White, in oil, kegs	lb.	.11½–	.12½
Red, dry, casks	lb.	.10½–	....
Red, in oil, kegs	lb.	.12½–	.13½
Lead acetate, white crys., bbl.	lb.	.14½–	....
Brown, broken, casks	lb.	.13½–	....
Lead arsenate, powd., bbl.	lb.	.16 –	.18
Lime-Hydrated, bg, wks.	ton	10.50 –	12.50
Bbl., wks.	ton	18.00 –	19.00
Lime, Lump, bbl.	280 lb.	3.63 –	3.65
Litharge, comm., casks	lb.	.10 –	.10½
Lithopone, bags	lb.	.06½–	.06½
Magnesium carb., tech., bags	lb.	.08½–	.08½
Methanol, 95%, bbl.	gal.	.74 –	.76
Methanol, 97%, bbl.	gal.	.76 –	.78
Methanol, pure, tanks	gal.	.75 –	....
drums	gal.	.78 –	.80
bbl.	gal.	.83 –	.85
Methyl-acetone, t'ks.	gal.	.70 –	....
Nickel sal., double, bbl.	lb.	.09 –	.10½
Nickel salts, single, bbl.	lb.	.10 –	.11
Orange mineral, csk	lb.	.13½–	.14½
Phosgene	....	.60 –	.75
Phosphorus, red, cases	lb.	.70 –	.75
Phosphorus, yellow, cases	lb.	.37½–	.40
Potassium bichromate, casks	lb.	.09 –	.09½
Potassium bromide, gran., bbl.	lb.	.22 –	.38
Potassium carbonate, 80-85%, calcined, casks	lb.	.05½–	.05½
Potassium chlorate, powd.	lb.	.07½–	.08½
Potassium cyanide, drums	lb.	.47 –	.52
Potassium, first sorts, cask	lb.	.07½–	.08
Potassium hydroxide (caustic potash) drums	lb.	.06½–	.06¾
Potassium iodide, cases	lb.	3.65 –	3.75
Potassium nitrate, bbl.	lb.	.06 –	.07½
Potassium permanganate, drums	lb.	.13½–	.14
Potassium prussiate, red, casks	lb.	.35 –	.38
Potassium prussiate, yellow, casks	lb.	.18½–	....
Salammoniac, white, gran., casks, imported	lb.	.06¾ –	.06½
Salammoniac, white, gran., bbl., domestic	lb.	.07½–	.08
Gray, gran., casks	lb.	.08 –	.09
Salsoda, bbl.	100 lb.	1.20	1.40
Salt cake (bulk) works	ton	16.00 –	18.00
Soda ash, light, 58% flat, bulk, contract	100 lb.	1.25 –	....
bags, contract	100 lb.	1.38 –	....
Soda ash, dense, bulk, contract, basis 58%	100 lb.	1.35 –	....
bags, contract	100 lb.	1.45 –	....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 –	....
Soda, caustic, ground and flake, contracts, dr.	100 lb.	3.50 –	3.85
Soda, caustic, solid, 76% f. a.s. N. Y.	100 lb.	2.85 –	3.05
Sodium acetate, works, bbl.	lb.	.04½–	.05
Sodium bicarbonate, bulk	100 lb.	1.75 –	....
330-lb. bbl.	100 lb.	2.00 –	....
Sodium bichromate, casks	lb.	.07½–	.07½
Sodium bisulphate (niter cake)	ton	6.00 –	7.00
Sodium bisulphite, powd., U.S.P., bbl.	lb.	.04½–	.04½
Sodium chlorate, kegs	lb.	.06½–	.07
Sodium chloride	long ton	12.00 –	13.00
Sodium cyanide, cases	lb.	.19 –	.22
Sodium fluoride, bbl.	lb.	$0.08½–	$0.10
Sodium hyposulphite, bbl.	lb.	.02½–	.02
Sodium nitrite, casks	lb.	.08½–	.09
Sodium peroxide, powd., cases	lb.	.23 –	.27
Sodium phosphate, dibasic, bbl.	lb.	.03½–	.03¾
Sodium prussiate, yel. bbl.	lb.	.09½–	.10½
Sodium salicylic, drums	lb.	.38 –	.40
Sodium silicate (40°, drums)	100 lb.	.75 –	1.15
Sodium silicate (60°, drums)	100 lb.	1.75 –	2.00
Sodium sulphide, fused, 60-62% drums	lb.	.03½–	.03½
Sodium sulphite, crys., bbl.	lb.	.02½–	.03
Strontium nitrate, powd., bbl.	lb.	.09½–	.10
Sulphur chloride, yel drums	lb.	.04½–	.05
Sulphur, crude	ton	18.00 –	20.00
At mine, bulk	ton	16.00 –	18.00
Sulphur, flour, bag	100 lb.	2.25 –	2.35
Sulphur, roll, bag	100 lb.	2.00 –	2.10
Sulphur dioxide, liquid, cyl.	lb.	.08 –	.08
Tin bichloride, bbl.	lb.	.12½–	....
Tin oxide, bbl.	lb.	.48 –	....
Tin crystals, bbl.	lb.	.33 –	....
Zinc carbonate, bags	lb.	.12 –	.14
Zinc chloride, gran, bbl.	lb.	.06 –	.07½
Zinc cyanide, drums	lb.	.36½–	.37
Zinc dust, bbl	lb.	.08 –	.08½
Zinc oxide, lead free, bag	lb.	.07½–	....
5% lead sulphate, bags	lb.	.06½–	....
10 to 35 % lead sulphate, bags	lb.	.06½–	....
French, red seal, bags	lb.	.09½–	....
French, green seal, bags	lb.	.10½–	....
French, white seal, bbl.	lb.	.11½–	....
Zinc sulphate, bbl.	100 lb.	3.00 –	3.25

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.60 –	$0.65
Alpha-naphthol, ref., bbl.	lb.	.65 –	.75
Alpha-naphthylamine, bbl.	lb.	.35 –	.36
Aniline oil, drums	lb.	.16 –	.16½
Aniline salt, bbl.	lb.	.22 –	.23
Anthracene, 80%, drums	lb.	.70 –	.75
Anthraquinone, 25%, paste, drums	lb.	.75 –	.80
Benzaldehyde U.S.P., carboys	lb.	1.50 –	....
f.f.c. drums	lb.	1.60 –	....
tech, drums	lb.	68	.72
Benzene, pure, water-white, tanks, works	gal.	.25 –	....
Benzene, 90%, tanks, works	gal.	.23 –	....
Benzidine base, bbl.	lb.	.80 –	.82
Benzidine sulphate, bbl.	lb.	.70 –	.72
Benzoic acid, U.S.P., kegs	lb.	.75 –	.85
Benzoate of soda, U.S.P., bbl.	lb.	.65 –	.70
Benzyl chloride, 95-97%, ref. carboys	lb.	.35 –	....
Benzyl chloride, tech., drums	lb.	.25 –	....
Beta-naphthol, tech., bbl.	lb.	.24 –	.25
Beta-naphthylamine, tech.	lb.	.65 –	.70
Cresol, U.S.P., drums	lb.	.22 –	.26
Ortho-cresol, drums	lb.	.28 –	.32
Cresylic acid, 97%, works drums	gal.	.63 –	.67
95-97%, drums, works	gal.	.58 –	.61
Dichlorbenzene, drums	lb.	.07 –	.08
Diethylaniline, drums	lb.	.53 –	.58
Dimethylaniline, drums	lb.	.35 –	.37
Dinitrobenzene, bbl.	lb.	.15 –	.17
Dinitrochlorbenzene, bbl.	lb.	.21 –	.22
Dinitronaphthalen, bbl.	lb.	.30 –	.32
Dinitrophenol, bbl.	lb.	.35 –	.40
Dinitrotoluen, bbl.	lb.	.18 –	.20
Dip oil, 25%, drums	gal.	.26 –	.28
Diphenylamine, bbl.	lb.	.48 –	.50
H-acid, bbl.	lb.	.72 –	.75
Meta-phenylenediamine, bbl.	lb.	.95 –	1.00
Michlers ketone, bbl.	lb.	3.00 –	3.25
Monochlorbenzene, drums	lb.	.08 –	.10
Monoethylaniline, drums	lb.	1.20 –	1.30
Naphthalene, flake, bbl.	lb.	.04½–	.05½
Naphthalene, balls, bbl.	lb.	.05½–	.05½
Naphthionate of soda, bbl.	lb.	.60 –	.65
Naphthionic acid, crude, bbl.	lb.	.60 –	.62
Nitrobenzene, drums	lb.	.09 –	.09½
Nitro-naphthalene, bbl.	lb.	.25 –	.30
Nitro-toluene, drums	lb.	.13½–	.14
N-W acid, bbl.	lb.	1.00 –	1.05
Ortho-amidophenol, kegs	lb.	2.40 –	2.50
Ortho-dichlorbenzene, drums	lb.	.12 –	.13
Ortho-nitrophenol, bbl.	lb.	.95 –	1.00
Ortho-nitrotoluene, drums	lb.	.11 –	.12
Ortho-toluidine, bbl.	lb.	.12 –	.13
Para-aminophenol, base, kegs	lb.	1.20 –	1.25
Para-aminophenol, HCl, kegs	lb.	1.30 –	1.40
Para-dichlorbenzene, bbl.	lb.	.17 –	.20
Paranitraniline, bbl.	lb.	.68 –	.70
Para-nitrotoluene, bbl.	lb.	.50 –	.55
Para-phenylenediamine, bbl.	lb.	1.35 –	1.45
Para-toluidine, bbl	lb.	.72 –	.80
Phthalic anhydride, bbl.	lb.	.30 –	.34
Phenol, U.S.P., dr.	lb.	.25 –	.27
Picric acid, bbl.	lb.	.20 –	.22
Pitch, tanks, works	ton	25.00 –	30.00
Pyridine, imp., drums	gal.	3.75 –	4.00
Resorcinol, tech., kegs	lb.	1.30 –	1.40

Resorcinol, pure, kegs	lb.	$2.00 –	$2.25
R-salt, bbl.	lb.	.50 –	.55
Salicylic acid, tech., bbl.	lb.	.32 –	.33
Salicylic acid, U.SP., bbl.	lb.	.35 –	. .
Solvent naphtha, water-white, tanks	gal.	.25 –	....
Crude, tanks	gal.	.22 –	....
Sulphanilic acid, crude, bbl.	lb.	.16 –	.18
Tolidine, bbl.	lb.	1.00 –	1.05
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars, works	gal.	.26 –	....
Toluene, drums, works	gal.	.30 –	....
Xylidine, drums	lb.	.45 –	.48
Xylene, 5 deg.-tanks	gal.	.40 –	....
Xylene, com., tanks	gal.	.28 –	....

Naval Stores

Rosin B-D, bbl.	280 lb.	$5.50 –	$5.55
Rosin E-I, bbl.	280 lb.	5.65 –	5.70
Rosin K-N, bbl.	280 lb.	5.90 –	6.10
Rosin W.G.-W.W., bbl.	280 lb.	7.00 –	7.60
Wood rosin, bbl.	280 lb.	5.40 –	5.50
Turpentine, spirits of, bbl.	gal.	.83 –	.....
Wood, steam dist., bbl.	gal.	.72 –	.....
Wood, dest. dist., bbl.	gal.	.54 –	.55
Pine tar pitch, bbl.	200 lb.	5.50 –	.....
Tar, kiln burned, bbl.	500 lb.	10.50 –	.....
Retort tar, bbl.	500 lb.	10.50 –	.....
Rosin oil, first run, bbl.	gal.	.38 –	.....
Rosin oil, second run, bbl.	gal.	.43 –	.....
Rosin oil, third run, bbl.	gal.	.48 –	.....
Pine oil, steam dist.	gal.	.60 –	.....
Pine tar oil, com'l.	gal.	.30 –	.....

Animal Oils and Fats

Degras, bbl.	lb.	$0.03½–	$0.05½
Grease, yellow, loose	lb.	.07 –	.07½
Lard oil, Extra No. 1, bbl.	gal.	.85 –	.....
Lard compound, bbl.	lb.	.13½–	.13½
Neatsfoot oil 20 deg. bbl.	gal.	1.26 –	.....
No. 1, bbl.	gal.	.86 –	.88
Oleo Stearine		.13 –	.....
Oleo oil, No. 1, bbl.	lb.	.14½–	.....
Red oil distilled, d.p. bbl.	lb.	.08½–	.09
Saponified, bbl.	lb.	.08½–	.09
Tallow, extra, loose works	lb.	.07½–	.....
Tallow oil, acidless, bbl.	gal.	.82 –	.....

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.16 –	.....
Castor oil, No. 1, bbl.	lb.	.16½–	.....
Chinawood oil, bbl.	lb.	.14 –	.14½
Coconut oil, Ceylon, bbl.	lb.	.09½–	.09¾
Ceylon, tanks, N.Y.	lb.	.08½–	.08¾
Coconut oil, Cochin, bbl.	lb.	.10½–	.10¾
Corn oil, crude, bbl.	lb.	.12½–	.12¾
Crude, tanks, (f.o.b. mill)	lb.	.10½–	.....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.10½–	.....
Summer yellow, bbl.	lb.	.12½–	.....
Winter yellow, bbl.	lb.	.13 –	.13½
Linseed oil, raw, car lots, bbl.	gal.	.98 –	.....
Raw, tank cars (dom.)	gal.	.92 –	.....
Boiled, cars, bbl. (dom.)	gal.	1.00 –	.....
Olive oil, denatured, bbl.	gal.	1.15 –	1.20
Sulphur, (foots) bbl.	lb.	.09½–	.09½
Palm, Lagos, casks	lb.	.07½–	.....
Niger casks	lb.	.07½–	.....
Palm kernel, bbl.	lb.	.09½–	.....
Peanut oil, crude, tanks (mill)	lb	.11½–	.....
Peanut oil, refined, bbl.	lb.	.14½–	.15
Perilla, bbl.	lb.	.13 –	.13½
Rapeseed oil, refined, bbl.	gal.	.80 –	.....
Sesame, bbl.	lb.	.11½–	.12½
Soya bean (Manchurian), bbl.	lb.	.11½–	.11½
Tank, f.o.b. Pacific coast	lb.	.10½–	.....
Tank, (f.o.b. N.Y.)	lb.	.10½–	.....

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.60 –	$0.62
Menhaden, light pressed, bbl.	gal.	.54 –	.....
White bleached, bbl.	gal.	.56 –	.....
Blown, bbl.	gal.	.60 –	.....
Crude, tanks (f.o.b. factory)	gal.	.40 –	.....
Whale No. 1 crude, tanks, coast	lb.	..... –	.....
Winter, natural, bbl.	gal.	.75 –	.76
Winter, bleached, bbl.	gal.	.78 –	.79

Oil Cake and Meal

Coconut cake, bags	ton	$30.00 –	32.00
Cottonseed meal, f.o.b. mills	ton	40.00 –	41.00
Linseed cake, bags	ton	41.00 –	.....
Linseed meal, bags, spot	ton	43.00 –	44.00

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.50 –	$0.55
Albumen, egg, tech, kegs	lb.	.95 –	.97
Cochineal, bags	lb.	.33 –	.35
Cutch, Borneo, bales	lb.	.04½–	.04¾
Cutch, Rangoon, bales	lb.	.13½–	.14½
Dextrine, corn, bags	100 lb.	4.32 –	4.37
Dextrine gum, bags	100 lb.	4.62 –	4.89
Divi-divi, bags	ton	40.00 –	42.00
Fustic, sticks	ton	30.00 –	35.00
Fustic, chips, bags	lb.	.04 –	.05
Gambier com., bags	lb.	.12 –	.13
Logwood, sticks	ton	25.00 –	26.00
Logwood, chips, bags	lb.	.02½–	.03
Sumac, leaves, Sicily, bags	ton	165.00 –	170.00
Sumac, ground, bags	ton	155.00 –	160.00
Sumac, domestic, bags	ton	50.00 –	55.00
Starch, corn, bags	100 lb.	3.67 –	3.94
Tapioca flour, bags	lb.	.04½–	.06

Extracts

Archil, conc., bbl.	lb.	$0.16 –	$0.19
Chestnut, 25% tannin, tanks	lb.	.01½–	.02
Divi-divi, 25% tannin, bbl.	lb.	.04½–	.05½
Fustic, crystals, bbl.	lb.	.20 –	.22
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09
Gambier, liq., 25% tannin, bbl.	lb.	.11 –	.11½
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.03½–	.04
Hypernic, solid, drums	lb.	.22 –	.24
Hypernic, liquid, 51°, bbl.	lb.	.12 –	.13
Logwood, crys., bbl.	lb.	.14 –	.15
Logwood, liq., 51°, bbl.	lb.	.07½–	.08½
Osage Orange, 51°, liquid, bbl.	lb.	.07 –	.08
Osage Orange, powder, bg.	lb.	.14 –	.15
Quebracho, solid, 65% tannin, bbl.	lb.	.04½–	.04½
Sumac, dom., 51°, bbl.	lb.	.06½–	.07

Dry Colors

Blacks–Carbongas, bags, f.o.b. works, contract	lb.	$0.09 –	$0.11
spot, cases	lb.	.12 –	.16
Lampblack, bbl.	lb.	.12 –	.40
Mineral, bulk	ton	35.00 –	45.00
Blues–Bronze, bbl.	lb.	.38 –	.40
Prussian, bbl.	lb.	.38 –	.40
Ultramarine, bbl.	lb.	.08 –	.35
Browns, Sienna, Ital., bbl.	lb.	.06 –	.14
Sienna, Domestic, bbl.	lb.	.03½–	.04
Umber, Turkey, bbl.	lb.	.04 –	.04½
Greens–Chrome, C.P. Light, bbl.	lb.	.28 –	.30
Chrome, commercial, bbl.	lb.	.11½–	.12
Paris, bulk	lb.	.24 –	.26
Reds Carmine No. 40, tins	lb.	4.25 –	4.50
Iron oxide red, casks	lb.	.08 –	.12
Para toner, kegs	lb.	.95 –	1.00
Vermilion, English, bbl.	lb.	1.25 –	1.30
Yellow, Chrome, C.P. bbls.	lb.	.17 –	.17½
Ocher, French, casks	lb.	.02½–	.03

Waxes

Bayberry, bbl.	lb.	$0.21 –	$0.21½
Beeswax, crude, Afr. bg.	lb.	.25 –	.26
Beeswax, refined, light, bags	lb.	.32 –	.34
Beeswax, pure white, cases	lb.	.40 –	.41
Candellila, bags	lb.	.23 –	.23½
Carnauba, No. 1, bags	lb.	.39 –	.40
No. 2, North Country, bags	lb.	.28 –	.29
No. 3, North Country, bags	lb.	.21 –	.22
Japan, cases	lb.	.20 –	.21
Montan, crude, bags	lb.	.05½–	.06
Paraffine, crude, match, 105-110 m.p., bbl.	lb.	.05½–	....
Crude, scale 124-126 m.p. bags	lb.	.04½–	....
Ref., 118-120 m.p., bags	lb.	.05 –	....
Ref., 123-125 m.p., bags	lb.	.05½–	....
Ref, 128-130 m.p., bags	lb.	.05½–	.05½
Ref., 133-135 m.p., bags	lb.	.06½–	.07
Ref., 135-137 m.p., bags	lb.	.07½–	.07½
Stearic acid, agle pressed, bags	lb.	.10½–	....
Double pressed, bags	lb.	.11 –	....
Triple pressed, bags	lb.	.12½–	....

Fertilizers

Acid phosphate, 16%, bulk, works	ton	$7.50 –	$7.75
Ammonium sulphate, bulk f.o.b. works	100 lb.	2.50 –	.....
Blood, dried, bulk	unit	4.10 –	4.15
Bone, raw, 3 and 50, ground	ton	26.00 –	28.00
Fish scrap, dom., dried, wks.	unit	..... –	.....
Nitrate of soda, bags	100 lb.	2.45 –	.....
Tankage, high grade, f.o.b. Chicago	unit	2.50 –	.....
Phosphate rock, f.o.b. mines			
Florida pebble, 68-72%	ton	3.25 –	3.70
Tennessee, 75%	ton	6.75 –	7.00
Potassium muriate, 80%, bags	ton	34.55 –	.....
Potassium sulphate, bags basis 90%	ton	45.85 –	.....
Double manure salt	ton	26.35 –	.....
Kainit	ton	7.22 –	.....

Crude Rubber

Para—Upriver fine	lb.	$0.22½–	.....
Upriver coarse	lb.	.14½–	.....
Upriver caucho ball	lb.	.15 –	.....
Plantation—First latex crepe	lb.	.23 –	.....
Ribbed smoked sheets	lb.	.22½–	.....
Amber crepe No. 1	lb.	.22 –	.....

Gums

Copal, Congo, amber, bags	lb.	$0.09 –	$0.14
East Indian, bold, bags	lb.	.13 –	.14
Manila, pale, bags	lb.	.18 –	.19
Pontinak, No. 1 bags	lb.	.19 –	.20
Damar, Batavia, cases	lb.	.23 –	.23½
Singapore, No. 1, cases	lb.	.27 –	.27½
Singapore, No. 2, cases	lb.	.18½–	.19
Kauri, No. 1, cases	lb	.58 –	.64
Ordinary chips, cases	lb.	.21 –	.22
Manjak, Barbados, bags	lb.	.06 –	.09

Shellac

Shellac, orange fine, bags	lb.	$0.54 –	$0.55
Orange superfine, bags	lb.	.56 –	.57
A. C. garnet, bags	lb.	.52 –	....
Bleached, bonedry	lb.	.63 –	.64
Bleached, fresh	lb.	.52 –	.53
T. N., bags	lb.	.52 –	.53

Miscellaneous Materials

Asbestos, crude No. 1 f.o.b., Quebec	sh. ton	$300.00 –	$400.00
Asbestos, shingle, f.o.b. Quebec	sh. ton	50.00 –	70.00
Asbestos, cement, f.o.b., Quebec	sh. ton	20.00 –	25.00
Barytes, grd., white, f.o.b. mills, bbl.	net ton	16.00 –	17.00
Barytes, grd., off-color, f.o.b. Balt.	net ton	13.00 –	14.00
Barytes, floated, f.o.b. St. Louis, bbl.	net ton	23.00 –	24.00
Barytes, crude f.o.b. mines, bulk	net ton	8.00 –	9.00
Casein, bbl., tech.	lb.	.10½–	.12
China clay (kaolin) crude,			
No. 1, f.o.b. Ga.	net ton	7.00 –	8.00
Washed, f.o.b. Ga.	net ton	8.50 –	9.00
Powd., f.o.b. Ga.	net ton	14.00 –	20.00
Crude f.o.b. Va.	net ton	6.00 –	8.00
Ground, f.o.b. Va.	net ton	13.00 –	19.00
Imp., lump, bulk	net ton	15.00 –	20.00
Imp., powd.	net ton	45.00 –	50.00
Feldspar, No. 1 f.o.b. N.C.	long ton	7.00 –	7.50
No. 2 f.o.b. N.C.	long ton	4.50 –	5.00
No. 1 gr'd. N. C.	long ton	15.32 –	21.00
No. 1 Canadian, f.o.b. mill, powd.	long ton	20.00 –	.....
Graphite, Ceylon, lump, first quality, bbl.	lb.	.05½–	.06
Ceylon, chip, bbl.	lb.	.04½–	.05
High grade amorphous crude	ton	15.00 –	35.00
Gum arabic, amber, sorts, bags	lb.	.11½–	.11¾
Gum tragacanth, sorts, bags	lb.	.50 –	.51
No. 1, bags	lb.	1.20 –	.....
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N. Y.	ton	50.00 –	55.00
Magnesite, calcined, f.o.b. Cal. ton		35.00 –	45.00
Pumice stone, imp., casks	lb.	.03 –	.40
Dom., lump, bbl.	lb.	.06 –	.08
Dom., ground, bbl.	lb.	.03 –	.05
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.50
Silica, sand blast, f.o.b. Ind.	ton	2.25	3.50
Silica, amorphous, 200-mesh, f.o.b. Ill.	ton	20.00 –	.....
Silica, glass sand, f.o.b. Ill.	ton	2.00 –	2.50
Soapstone, coarse, f.o.b. Vt., bags	ton	7.50 –	8.00
Talc, 200 mesh, f.o.b., Vt., bags, extra	ton	10.50 –	.....
Talc, 200 mesh, f.o.b. Ga., bags	ton	8.00 –	10.00
Talc, 325 mesh, f.o.b. New York, grade A bags	ton	14.75 –	.....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3.00 –	$3.25
Corning	bbl.	1.80 –	.....
Cabell	bbl.	1.60 –	.....
Somerset	bbl.	1.70 –	.....
Illinois	bbl.	1.97 –	.....
Indiana	bbl.	1.98 –	.....
Kansas and Okla. under 28 deg.	bbl.	.90 –	.....
California, 35 deg. and up	bbl.	1.40 –	.....

Gasoline, Etc.

Motor gasoline, steel bbls.	gal.	$0.19 –	.....
Naphtha, V. M. & P. deod, steel bbls	gal	.18 –	.....
Kerosene, ref tank wagon	gal.	.14 –	.....
Bulk, W.W. delivered, N.Y.	gal.	.08 –	.....
Lubricating oils:			
Cylinder, Penn., filtered	gal.	.30 –	.35
Bloomless, 30@31 grav.	gal.	.21 –	.22
Paraffin, pale 885 vis.	gal.	.16 –	.17
Spindle, 200, pale	gal.	.22 –	.....
Petrolatum, amber, bbls.	lb.	.04 –	.04½
Paraffine wax (see waxes)			

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140–$145
Chrome brick, f.o.b. Eastern shipping points	ton	45–47
Chrome cement, 40-50% Cr_2O_3	ton	23–27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	42–45
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	35–38
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–68
9-in. arches, wedges and keys	ton	80–85
Scraps and splits	ton	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–50
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	48–50
F.o.b. Mt. Union, Pa.	1,000	38–40
Silicon carbide refract. brick, 9-in.	1,000	1,180.00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y.	ton	$200.00 – .....

Ferrochromium, per lb. of Cr, 1-2% C	lb.	$0.30 -
4-6% C	lb.	.11½ -
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	107.50 -
Spiegeleisen, 19-21% Mn	gr. ton	35.00 - 36.00
Ferromolybdenum, 50-60% Mo, per lb. Mo	lb.	2.00 - 2.25
Ferrosilicon, 10-12%	gr. ton	39.50 - 43.50
50%	gr. ton	75.00 -
Ferrotungsten, 70-80%, per lb. of W	lb.	.90 - .93
Ferro-uranium, 35-50%, o U, per lb. of U	lb.	4.50 -
Ferrovanadium, 30-40%, per lb. of V	lb.	3.50 - 4.00

Ores and Semi-finished Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$5.50 - $8.75
Chrome ore Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 -
C.i.f. Atlantic seaboard	ton	19.00 - 23.00
Coke, fdry., f.o.b. ovens	ton	4.25 - 4.50
Coke, furnace, f.o.b. ovens	ton	3.00 - 3.25
Fluorspar, gravel, f.o.b. mines, Illinois	ton	23.50 -
Ilmenite, 52% TiO_2 Va	lb.	.01½ -
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.42 - .46
Manganese ore, chemica (MnO_2)	ton	75.00 - 80.00
Molybdenite, 85% MoS_2, per lb. MoS_2, N. Y.	lb.	.80 -
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 - .08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ - .12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.11½ - .12
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12 -
Rutile, 94@96% TiO_2	lb.	.12 - .13
Tungsten, scheelite, 60% WO_3 and over	unit	9.25 -
Tungsten, wolframite, 60% WO_3	unit	9.00 - 9.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 - 3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	12.25 - 2.50
Vanadium pent oxide, 99%	lb.	2.00 - 14.00
Vanadium ore, per lb. V_2O_5	lb.	1.00 - 1.25
Zircon, 99%	lb.	.06 - .07

Non-Ferrous Metals

Copper, electrolytic	lb.	$0.12½ - $0.12½
Aluminum, 98 to 99%	lb	.27 - .28
Antimony, wholesale, Chinese and Japanese	lb.	.08½ - .08½
Nickel, 99%	lb.	.27 - .30
Monel metal, shot and blocks	lb.	.32
Tin, 5-ton lots, Straits	lb.	.45½
Lead, New York, spot		07
Lead, E. St. Louis, spot	lb.	0670
Zinc, spot, New York	lb.	.0620
Zinc, spot, E. St. Louis	lb.	0585
Silver (commercial)	oz.	.67½
Cadmium	lb.	60
Bismuth (500 lb. lots)	lb	2.35-2.40
Cobalt	lb.	2.50-3.00
Magnesium, ingots, 99%	lb.	90-.95
Platinum, refined	oz.	116.00
Iridium	oz.	260.00-270.00
Palladium, refined	oz.	78.00-83.00
Mercury	75 lb.	73.00-74.00
Tungsten powder	lb	.95-1.00

Finished Metal Products

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	18.25
Copper bottoms	28.00
Copper rods	18.75
High brass wire	16.75
High brass rods	14.00
Low brass wire	18.50
Low brass rods	19.50
Brazed bronze tubing	23.75
Seamless copper tubing	21.75
Seamless high brass tubing	20.50

OLD METALS—The following are the dealers purchasing prices in cents per pound

Copper, heavy and crucible	9.50 @ 9.75
Copper, heavy and wire	9.25 @ 9 37½
Copper, light and bottoms	7.50 @ 7.75
Lead, heavy	5.50 @ 5.75
Lead, tea	3.50 @ 3 62½
Brass, heavy	4.75 @ 5.00
Brass, light	4.00 @ 4.25
No. 1 yellow brass turnings	6.00 @ 6.25
Zinc scrap	3.37½ @ 3.50

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Chicago
Structural shapes	$3.44	$3.44
Soft steel bars	3.34	3.34
Soft steel bar shapes	3.54	3.54
Soft steel bands	4.09	4.0
Plates, ¼ to 1 in. thick	3.44	3.44

Industrial

Financial, Construction and Manufacturing News

Construction and Operation

Arkansas

ROGERS—The Page Copper & Gold Mining Co. has plans under advisement for the installation of additional equipment at its plant for considerable increase in output, including power apparatus.

California

ANAHEIM—The Crystal Chemical Co., specializing in the production of denatured alcohol, etc., is arranging a fund of about $500,000, for extensions and improvements in its plant, to be carried out over a period of months. The expansion will include new buildings and equipment. Initial work will include the installation of a department for the production of commercial fertilizer products and it is expected to have this ready for service in the near future. The company also purposes to install equipment for purifying and odor elimination.

LOS ANGELES—The Porter Mirror & Glass Co., affiliated with the Shelbyville Mirror Works, Shelbyville, Ind., has commenced the erection of a new local plant on site selected in the central manufacturing district. It will be 1-story, with reported cost stated at $50,000, including equipment. The works will be given over initially to the production of plate glass mirrors, to be extended to other lines in the future. Enos Porter heads the company.

BURBANK — Alfred Lingensjo, 711 East 6th St., is perfecting arrangements for the establishment of a local plant for the manufacture of cement blocks of special composition, designed to be damp-proof. Work will begin at an early date.

LOS ANGELES—The Sunset Glass Co., 4001 Goodwin Ave., recently organized, will establish a local plant for the manufacture of automobile and signal lenses, and kindred glass specialties, later to be extended to include the production of tableware products. W. S. Williams is chemist and general manager, in charge.

Florida

FORT PIERCE—The City Council has arranged for a bond issue of $500,000 for municipal improvements, to include the installation of a new filtration plant at the city waterworks, for which it is expected to ask bids at an early date.

Georgia

ATLANTA—The board of trustees, Georgia School of Technology, has commissioned Pringle & Smith, local architects, to prepare plans for the proposed addition to the chemistry building at the institution. It will be 3-story, estimated to cost $100,000. Bids will be asked in the near future. A list of equipment to be installed will soon be arranged. N. E. Harris is chairman of the board.

ATLANTA—The Logan-Long Roofing Co., manufacturer of asphalt roofing products, has awarded a general contract to McKeown Brothers Co., 112 West Adams St., Chicago, Ill., for the erection of a new plant on local site, estimated to cost $250,000, with equipment. Foundations will be laid at once.

Illinois

CHICAGO—The Carpenter Container Co., recently organized, has leased a portion of the building at West Pershing Rd. and So. Ashland Ave., totaling about 16,500 sq.ft., and will take immediate possession, installing equipment for the manufacture of fibre containers and kindred products.

Kansas

INDEPENDENCE—The National Sash & Door Co. is planning for improvements in its window glass department, including machinery replacements and repairs. The plant has temporarily curtailed to allow for the work, which is expected to require a month to 6 weeks.

Maryland

BALTIMORE—The Bethlehem Steel Co., Bethlehem, Pa., has plans nearing completion for the erection of three 1-story additions at its Sparrows Point plant, Baltimore, estimated to cost close to $100,000, including equipment. Work will begin at an early date.

BALTIMORE—Fire, July 4, destroyed a portion of the 5-story and 2-story plant buildings of the Crown Cork & Seal Co., Eastern Ave. and 11th St. An official estimate of loss has not been announced. It is planned to rebuild.

BALTIMORE—The Porcelain Enamel & Mfg. Co., Eastern Ave. and 23rd St., has awarded a general contract to the Truscon Steel Co., Builders Exchange Bldg., for the erection of a 1-story addition to its plant.

Massachusetts

WESTFIELD—The American Abrasive Co. will hold in temporary abeyance the erection of its proposed plant addition on Union St., for which plans have been prepared. It is expected to begin work early in the fall. M. B. Harding, 97 Elm St., is architect. H. E. Willcutt is treasurer.

Michigan

FLINT—The Flint Malleable Castings Co., Dayton Bldg., is taking bids on a general contract for the erection of a new 1-story foundry addition, for which foundations will soon be laid. Wright & Nice, Kearsley and Smith Sts., are architects.

MUNISING—The Cleveland-Cliffs Iron Co. has work in progress on improvements at its local properties, including the installation of dry kilns and other equipment, estimated to cost $20,000.

SAGINAW—The Dittmar & Raths Oil Co., Flint, Mich., has plans for the construction of a new storage and distributing plant on Durant St., Saginaw. J. Fred Brockbiseinger, 114 So. Jefferson St., Saginaw, is architect.

Minnesota

BEMIDJI—Earle A. Barker, Bemidji, and associates are perfecting plans for the erection of a peat-drying plant on site being selected near Bemidji, including the installation of a special dehydration system for such service. The material will be made into fuel briquets, and the plant equipment will include machinery for this purpose. A number of kilns will be constructed. It is expected to develop an output of about 100 tons of peat fuel daily. F. A. Plummer, Minneapolis, inventor of the dehydration process to be used, is interested in the project.

Mississippi

MOUND BAYOU—The Keystone Cotton Oil Co., recently organized, is said to have acquired the local plant of the Mound Bayou Cotton Oil Co., and plans for extensions and improvements for increased production. The new company is headed by J. H. Harvey and L. J. Martin, both of Memphis, Tenn.

Montana

MISSOULA—The Utah-Idaho Sugar Co., Salt Lake City, Utah, is perfecting plans for the immediate erection of a new mill on local site, reported to cost in excess of $250,000, with machinery. It will include a power house.

New Jersey

NUTLEY—The Hermetite Chemical Corp., 1664 Broadway, New York, manufacturer of lacquers, varnishes, waterproofing compounds, etc., has leased the former local plant of the American Nitration Co., Passaic River Rd., and will take immediate possession for a new plant. It consists of a main 2-story factory on a 5-acre tract of land, and will be improved by the new owner for the line of manufacture. An option has been secured to purchase the property, if desired, at a later date.

JERSEY CITY—The Mutual Chemical Co., 201 West Side Ave., has filed plans for the erection of a 1-story addition to its plant, to cost about $10,000.

TRENTON—The Pocono Rubber Cloth Co., 1851 East State St., has acquired the former factory of the H. D. Lee Mercantile Co., on East State St., and will take possession at once for a new plant. Equipment will be installed at an early date.

BAYONNE—The Bergen Point Brass Foundry, Ave. A and 6th St., has work in progress on a 1-story foundry addition, for which a contract was awarded recently to the Truscon Steel Co., 31 Union Sq. West, New York. It will cost about $15,000.

New York

LONG ISLAND CITY—Benjamin Newman, 65 5th Ave., New York, manufacturer of sanitary ware and products, has plans under way for the erection of a new plant at Buckley St. and Foster Ave., to be 4-story, 100x100 ft., estimated to cost about $120,000, including equipment. Benjamin Driesler, Jr., 153 Remsen St., Brooklyn, is architect.

TONAWANDA—The Republic Light, Heat & Power Co. has work in progress on extensions and improvements in its artificial gas plant on East Niagara St., for considerable increase in output, estimated to cost $100,000, with equipment.

TROY—The Burden Iron Co. has issued preferred stock for $700,000, the proceeds to be used for the acquisition of a substantial interest in the Hudson Valley Coke & Products Corp., which proposes to construct and operate a coke works and gas plant in this section. The entire project will involve in excess of $1,500,000.

North Carolina

GLENDON—The Pyro Talc Co., recently formed by Charles P. King, 43 Tremont St., Boston, Mass., and associates, with capital of $250,000, has acquired the local property and plant of the W. E. Paschal interests, consisting of about 150 acres of land and reduction mill. The present plant has a capacity of about 300 tons per week, and it is expected to advance this output at an early date. Other extensions and betterments will also be made. Mr. King will be president of the new company; Henry W. Whitaker, 104 Ward St., Newton Center, Mass., is treasurer.

Ohio

LIMA—The Air Reduction Sales Co., 342 Madison Ave., New York, manufacturer of industrial oxygen, gases, etc., has commenced the erection of the first unit of its proposed local plant on site at Atlantic Ave. and the Erie Railroad, 185x250 ft., estimated to cost $60,000. Other units will be constructed later to make a total investment approximating $250,000, with machinery.

GENEVA—The Geneva Metal Wheel Co. has awarded a general contract to J. H. O'Grody, 2954 Kensington Rd., Cleveland, O., for the erection of a 2-story cupola building at its plant, estimated to cost about $20,000.

COLUMBUS—The Central Ohio Oil Co. is reported to be planning for the rebuilding of the portion of its local oil storage and distributing works, recently destroyed by fire with loss in excess of $100,000, including equipment.

LIMA—The Lima Gas Light Co., has awarded a general contract to the Lima Construction Co., for the erection of an addition to its local artificial gas plant, estimated to cost $250,000. Of this amount, close to $150,000 will be expended for additional equipment.

Oklahoma

OKLAHOMA CITY—Felix Folmar, 412 Baltimore Bldg., Oklahoma City, plans for the early purchase of machinery for a local fertilizer-mixing plant, including accessory operating equipment.

TONKAWA—The Marland Refining Co., Ponca City, Okla., is said to be planning for the construction of a new oil storage and distributing plant on local site, estimated to cost more than $85,000.

Pennsylvania

CLARENCE—J. H. France, until recently general manager of plants for the General Refractories Co., 117 So. 16th St., Philadelphia, Pa., has acquired the local plant and business of the Snow Shoe Fire Brick Co., which has been inactive for a number of months past. The new owner plans for improvements and betterments, and will place the works in service at an early date for firebrick and other refractory production.

PHILADELPHIA—The Bisbee Linseed Oil Co., Delaware Ave. and Bigler St., plans for the rebuilding of the portion of its plant damaged by fire, July 3, with loss reported at $12,000.

Texas

ORANGE—The Seaboard Oil & Refining Co., has plans under way for the construction of an addition to its refinery, to include the installation of additional equipment for extensive increase in production. A. C. White, manager of the Sycamore Oil Co., will be in charge of the work.

HOUSTON—The Union Carbide & Carbon Co., 30 East 42nd St., New York, is said to have tentative plans under advisement for the erection of a new plant in the vicinity of Houston, to be occupied by its Linde Air Products and Prest-O-Lite divisions, for the manufacture of commercial gases, oxygen, etc. The cost is said to be estimated in excess of $275,000, with equipment.

Virginia

RICHMOND—The Laird Mfg. Co., 206 Brander St., manufacturer of baking powders and kindred specialties, has acquired property at Perry and 7th Sts., and will use for a new plant. The structure will be remodeled and equipment installed. W. L. Taylor is president.

Wisconsin

SHEBOYGAN—The Midwest Fibre Co. has preliminary plans under advisement for the rebuilding of the portion of its plant, recently destroyed by fire with loss estimated at close to $95,000, including equipment.

New Companies

MOON PRODUCTS, INC., New York, N. Y.; chemicals and chemical byproducts; active capital $75,000. Incorporators: M. L. and E. Simon, and M. Neustadt. Representative: Lawrence & Wiseman, 220 Broadway, New York.

WONDER MFG. CO., INC., 760 Pingree Ave., Detroit, Mich.; fire extinguisher powders, etc.; capital not stated. Incorporators: John W. Husted and Frank J. Cushing.

QROIL CO., Attleboro, Mass.; chemicals and kindred products; $50,000. William H. Saart, Attleboro, president and treasurer.

STARR MICA CO., Heflin, Ala.; mica products; $10,000. Incorporators: G. Cohn and John M. Zeeman, both of Heflin.

UNIVERSITY LABORATORIES, INC., 44 Main St., Champaign, Ill.; chemical products; $10,000. Incorporators: R. O. Black, F. F. Munson and C. R. Iungerich.

RED BIRD GUANO CO., Cocoanut Grove, Fla.; fertilizer products; $10,000. Cornelius Christiancy is president, and DeF. L. Christiancy secretary, both of Cocoanut Grove.

MALCOLM FOUNDRY CO., INC., Newark, N. J.; iron and steel castings; $25,000. Incorporators: John Williams, Harold T. and Thomas Malcolm, 67 Polk St., Newark. The last noted is representative.

BELINKY & MERINO, INC., Brooklyn, N. Y.; mirrors and other glass products; $20,000. Incorporators: M. Belinky, L. Marino and A. Florentino. Representative: A. J. Todaro, 2411 Myrtle Ave., Brooklyn.

DEER CREEK GASOLINE CO., Tulsa, Okla.; operate a gasoline-refining plant; $25,000. Incorporators: R. C. Jones, Cushing, Okla., and D. E. Foster, 243 Lynch Bldg., Tulsa. Last noted is representative.

LEHIGH DENATURED ALCOHOL CORP., New York; denatured alcohol and kindred products; $10,000. Incorporators: J. and J. E. Paris, and F. A. Vella. Representative: G. E. Miner, 32 Liberty St., New York.

WYNN PAPER PRODUCTS, CO., Boston, Mass.; paper goods; $100,000. John J. Wynn is president, and Grace M. Wynn, 68 Western Ave., Boston, treasurer and representative.

ROANOKE CONCRETE PIPE CO., Roanoke, Va.; concrete pipe and other cast cement products; $100,000. G. D. Shipplett is president, and C. F. Cooke secretary, both of Roanoke.

YUNCK GLASS MFG. CORP., Jersey City, N. J., care of the Corporation Trust Co., 15 Exchange Pl., Jersey City, representative; glass products; $100,000.

BERNARD PAPER CO., 434 West 12th Pl., Chicago, Ill.; paper products; $40,000. Incorporators: Fred I. Simon, A. and Charles D. Bernard.

TEAPOT DOME OIL CO. OF TEXAS, INC., Vernon, Tex.; petroleum products; $30,000. Incorporators: L. K. Johnson, R. H. Coffee and A. P. Peck, all of Vernon.

COAL TAR DYES, INC., New York, N. Y.; dyestuffs and chemicals; $50,000. Incorporators: J. Friedman and J. F. Hollywood. Representative: P. J. O'Beirne, 132 Nassau St., New York.

MINERAL PRODUCTS CORP., Jersey City, N. J.; mine and compound mineral specialties. Incorporators: Sidney H. Anderson, William E. Reuter and John F. Hurley, 999 Bergen Ave., Jersey City. The last noted is representative.

WILLESEN MFG. CO., Malden, Mass.; gasoline, turpentine and kindred products; $100,000. William J. Good is president, and William T. Snow, 117 Bay State Rd., Boston, Mass., treasurer and representative.

LYONS FERTILIZER CO., Tampa, Fla.; commercial fertilizers; $250,000. Incorporators: Charles W. Lyons (president), and W. L. Waring, Jr. (secretary), both of Tampa.

MIRROFLASH CO., 543 West Lake St., Chicago, Ill.; liquid wax, cleaning compounds, etc.; 250 shares of stock, no par value. Incorporators: Glenn M. and V. C. Johnson, and Eugene Maercklin.

STERLING DRUG & CHEMICAL CO., care of the United States Corporation Co., Dover, Del., representative; chemicals, compounds, etc.; $1,000,000.

SARMAC CORP., New York, N. Y.; chemicals and chemical byproducts; 200 shares of stock, no par value. Incorporators: H. W. Paprocki, C. J. Ferrie and F. H. Butehorn. Representative: F. J. Knorr, Albany, N. Y., attorney.

NATURE'S MINERAL PRODUCTS CO., Hot Springs, Ark.; mine and compound mineral specialties for fertilizer and other purposes; $100,000. Incorporators: W. F. McCormick and W. H. Harry, Citizens National Bank Bldg., Hot Springs. The last noted is secretary and representative.

NATIONAL CHEMICAL SERVICE CO., 88 Smithfield Ave., Providence, R. I.; organized; chemical specialties. Graham N. Gleysteen, 304 Washington St., Providence, heads the company.

MIDAS CORP., Philadelphia, Pa.; soaps and kindred products; $50,000; care of the Capital Trust Co. of Delaware, Dover, Del., representative. Incorporators: August G. Gruber, William H. Hahn and Rupert C. Schaeffer, all of Philadelphia.

FREE STATE OIL CO., Terrell, Tex.; refined petroleum, etc.; $41,000. Incorporators: R. R. Holmes, W. A. Buttram and E. R. Newby, all of Terrell.

STOTT & HOLTZ, INC., New York, N. Y.; waterproofing compounds; $30,000. Incorporators: S. E. Stott, R. B. Holtz and W. M. Duncan. Representative: M. B. Rich, 66 Broadway, New York.

ELATERITE PAINT CO., INC., Newark, N. J.; paints, varnishes, etc.; $250,000. Incorporators: George H. Mulvey, Louis M. Rosenberg and Frederick G. Ross, 51 Rome St., Newark. The last noted is representative.

ORANGE STATE OIL CO., Miami, Fla.; petroleum products; $50,000. E. N. Belcher is president, and C. B. Chinn, secretary, both of Miami.

POROUS PRODUCTS CORP., Wilmington, Del., care of the Corporation Service Co., Equitable Bldg., Wilmington, representative; insulating brick and kindred specialties; $500,000.

WHEATLEY OIL CO., San Antonio, Tex.; petroleum products; $150,000. Incorporators: C. A. Wheatley, J. S. Daniel and H. V. Wheatley, all of San Antonio.

STANDARD LACQUER CO., New York, N. Y.; lacquers and kindred products; $50,000. Incorporators: J. Gold, M. and J. Lerner. Representative: Ort & Forst, 280 Broadway, New York.

Industrial Notes

THE AMERICAN KATALITE CORPORATION has moved from 233 Broadway to 99 Hanson Place, Brooklyn, N. Y., where the office and factory are located.

THE VULCAN IRON WORKS, of Wilkes-Barre, Pa., has secured control of the Meade patents for vertical limekilns and the Zepp patents for an automatic continuous batch hydrator, and these machines hereafter will be exclusively manufactured by it. Both of these machines are the products of Richard K. Meade & Co., of Baltimore, Md., whose vast experience in lime burning and kindred lines makes their design of machinery valuable on account of this experience. The Vulcan Iron Works is now prepared to quote on and build complete lime burning and hydrating plants, using either the Meade vertical kiln or the Vulcan rotary kiln for lime burning. Circulars covering these added lines will be ready for distribution shortly.